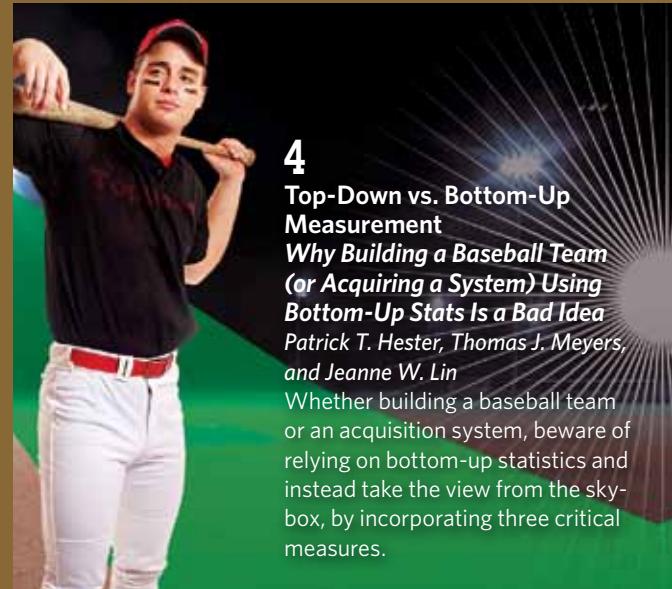# Top-Down vs. Bottom-Up Measurement

Why Building a Baseball Team
(or Acquiring a System)
Using Bottom-Up Stats Is a Bad Idea

The Optimal Program Structure
Thoughts from the Acting Under Secretary of Defense (AT&L)

Building Rome in a Day
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The Optimal Program Structure

Frank Kendall
Acting Under Secretary of Defense (AT&L)

Not too long ago, I was asked during a Q&A session with one of the courses at DAU what I thought the optimal program structure was. The question itself suggests a misunderstanding of how programs should be structured, and more importantly, it may be an example of a type of behavior that I've seen too much of in the past two years since I came back to government service.

The answer to the question is either: (A) There is none, or (B) There are an infinite number. There is no one best way to structure a program. Every program has its own best structure, and that structure is dependent on all the many variables that contribute to program success or failure. To paraphrase and invert Tolstoy, happy programs are each happy in their own way, and unhappy programs tend to be unhappy in the same ways.

As I went around the country a year ago to discuss the Better Buying Power initiatives with the workforce, one thing I tried to emphasize repeatedly was that the BBP policies were not set in stone. All were subject to waiver. The first responsibility of the key leaders in the acquisition workforce is to think. One of the many reasons that our key leaders have to be true professionals who are fully prepared to do their jobs by virtue of education, training, and experience is that creative, informed thought is necessary to optimize the structure of a program. The behavior I'm afraid I've seen too much of is the tendency to default to a "school solution" standard program structure. I've seen programs twisted into knots just to include all the milestones in the standard program template. I'm guessing that there are two reasons our leaders would do this: first, because they don't know any better, and second, because they believe it's the only way to get their program approved and through the "system." Neither of these leads to good outcomes, and neither is what I expect from our acquisition professionals.

So how does one determine how to best structure a program? Whether you are a PM, or a chief engineer, or a contracting officer, or a life cycle support manager, you have to start in the same place. You begin with a deep understanding of the nature of the product you intend to acquire. The form of the program has to follow the function the program will perform: developing and acquiring a specific product. The nature of the product should be the most significant determiner of program structure. How mature is the technology that will be included in the product? What will have to be done to mature that technology, and how much

I've seen programs twisted into knots just to include all the milestones in the standard program template.

risk is involved? In addition to the technology that is included, how complicated will the design be? Is it like other designs that we have experience with, or is it novel? How difficult are the integration aspects of building the product? Is the manufacturing technology also mature, or will work have to be done to advance it prior to production? These questions on a large scale will begin the process of determining if a technology development phase is needed prior to the start of engineering and manufacturing development. They will also affect the duration of these phases, if used, and the number of test articles and types of testing that will have to be performed to verify the performance of the design.

Beyond a deep understanding of the product itself and the risk inherent in developing and producing it, one must consider a range of other factors that will influence program structure. How urgently is the product needed? How prepared is industry to design and produce the product? How much uncertainty is there about the proper balance of cost and capability? What are the customer's priorities for performance? What resource constraints will affect program risk (not just financial resources, but also availability of competitors, time, and expertise in and out of government)? Is cost or schedule most important and what are the best ways to control them on this program? What is the right balance of risk and incentives to provide to the contractors to get the results the government wants?

We are not in an easy business. This is in fact rocket science in many cases. As I look at programs coming through the acquisition process, my fundamental concern is that each program be structured in a way that optimizes that program's chances of success. There is no one solution. What I'm looking for fundamentally is the evidence that the program's leaders have thought carefully about all of the factors that I've mentioned—and many others. I look for that evidence in the nature of the product the program is acquiring and in the structure the program's leaders have chosen to use. The thinking (and the supporting data) that went into determining that specific and often unique structure is what I expect to see in an acquisition strategy, and it is what I expect our leaders to be able to explain when they present their program plans.

Top-Down VS Bottom-Up Measurement

Why Building a Baseball Team (or Acquiring a System) Using Bottom-Up Stats Is a Bad Idea

Patrick T. Hester ■ *Thomas J. Meyers* ■ *Jeanne W. Lin*

The success of the Hollywood movie *Moneyball* is an opportunity to explore a notion of systems acquisition that is significant yet often overlooked: that of the essential, acquisition "team" contributions to be made by "players" known as critical operational issues (COIs), measures of effectiveness (MOEs), and measures of performance (MOPs). While reasons for this oversight vary—ranging from inattention to assumptions of "We already do that"—insufficient attention to these concepts

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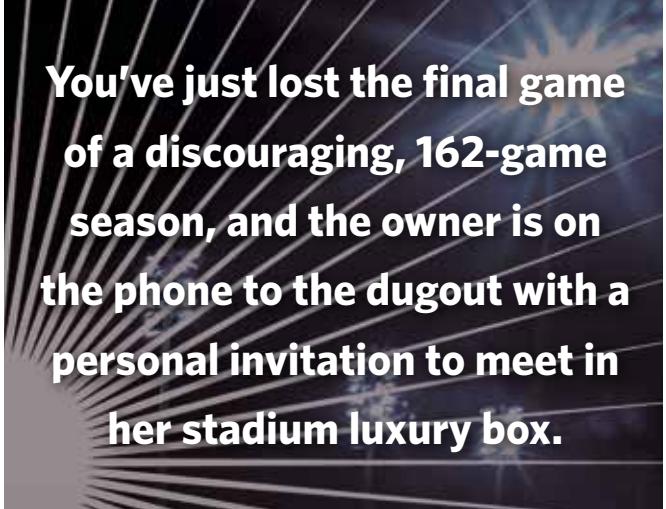
nonetheless remains in the acquisition community. Accordingly, the world of baseball and its familiarity to the many "fans" who pack the stands of this nation's procurement "ballparks" can, indeed, provide the systems acquisition fan base with a metaphor well-suited to its own team goals.

This article uses that baseball metaphor and a sequence of three scenarios to highlight what baseball fans and system acquisition enthusiasts alike should avoid, what they should embrace, and what they can achieve if they embrace the inspirational play of their COI, MOE, and MOP prospects. So let's just sit back and enjoy the game, shall we?

If You Want to Be a Cellar Dweller

Congratulations, Skipper! You've just been hired as the general manager (GM) of an expansion baseball team, and your first priority is to draw up your inaugural season's roster. You begin that task with a calculating review of players offered to the expansion draft by older clubs. One by one, you identify promising players you feel should wear the new team's uniform. Thinking big from the start, you first decide to draft a player for his exceptional onbase percentage, reasoning that an ability to get to the base paths will support your team's run production and hence its chances for the playoffs and World Series. You next choose a pitcher for his high strike-out-to-walk ratio because you feel that this particular performance statistic says much about the hurler's value over the long season to come. You continue filling your roster this way, using criteria readily available and appealing to ownership as reflecting desirable qualities and quantities of "goodness" or "desirability." When done, you'll ask yourself, "What has the completed roster really given me, the fans, and anyone else with a stake in what I hope will be a winning ball club?"

If you've used the full set of skills for which you were hired—probably with a little luck, to boot—your selection process might produce a fair number of wins over the season. On the other hand, a set of selections that is based too strongly on a player's performance stats such as onbase percentage or strike-out-to-walk ratio will have started your team—and per-

haps a certain truncated managerial career—on an unavoidable march to the cellar. At worst, you'll have compiled a squad of six right fielders and no one to play third base, or you'll have provided a home to five starting pitchers but little in the way of a bullpen. Far more believably, but still likely at best, you'll have pieced together a collection of individuals that fails to coalesce as a team and so fails to satisfy your customer: the fans. In that case, the question you'll probably ask yourself is, "Should I have trusted the season's performance to a scheme of team- or system-building that depends so heavily on readily available player-related data at the expense of more appropriate global, team-oriented desires?" Given the worst-case scenario or anything remotely close to it, you may expect the club's frustrated fans to answer that question for you, in language quite less sympathetic than, "Wait 'til next year!"

A Call to the Owner's Box

Congratulations again! You've just lost the final game of a discouraging, 162-game season, and the owner is on the phone to the dugout with a personal invitation to meet in her stadium luxury box. Her tone is stern, and you don't expect the impending conversation to end on a note as upbeat as "Wait 'til next year."

The owner is a smart woman who knows firsthand what it takes to be a winner. She understands "Who's on first" and "What's on second," but she finds it almost incomprehensible that you effectively doomed her team's opening season with an expansion draft effort that failed to claim three particular players who have proven their worth to the teams for which they've played. Those players are COIs, MOEs, and MOPs. How could you have expected, she wonders, to build a competitive team using a bottom-up approach that so greatly emphasized personal performance over team performance? "Every fan in the world," she's quick to tell you upon your arrival atop the ballpark, "knows how poorly individual stats can translate to team success! What were you thinking?" she adds, before allowing you some breathing room with a gracious, "May I offer you a few suggestions?" You wisely respond in the affirmative, and she proceeds to speak about a set of baseball facts that just happen to be every bit as important to systems acquisition arenas as they are to baseball diamonds.

Building a successful ball club is a largely top-down endeavor emphasizing team-related desires of owners, GMs, fans, and other club stakeholders. In order to meet such desires, a baseball team—or any such system, for that matter—should avail itself of team leaders like COIs and MOEs. While it's true enough that not a single stakeholder desire will be met without a fielded group of players, the individual qualities brought to the field by those players in no way guarantee that the team will succeed. They simply are what they are and will prove to be of value only if smartly exploited within the reality of team play. That is why personal stats like batting average are MOPs that, while undeniably important, shouldn't drive any GM's show. "Understand, Skipper?" she concludes. "If so, good, because as Costello said to Abbot, 'That's what I'm saying!'"

Figure 1: Baseball Fans' Problem and COIs

The Problem:
A baseball team's rabid fan base wants "a winner."

COI₁
Has our team won the championship or has it at least displayed the "stuff of champions"?

COI₂
Another possible critical issue...

COI₃
Another possible critical issue...
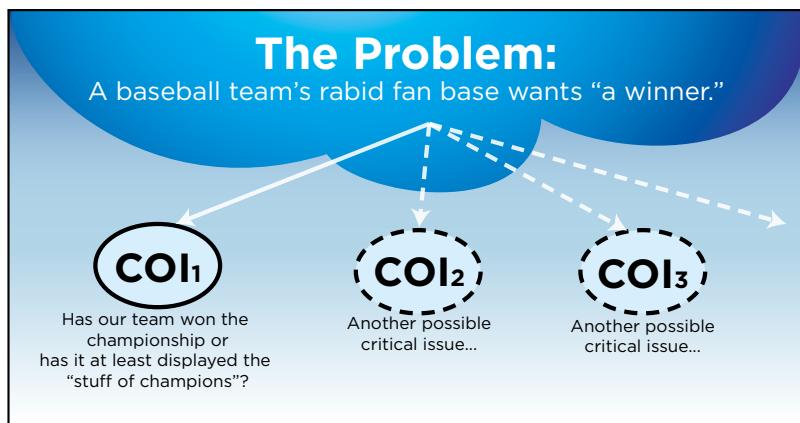
Giving the Fans What They Want

Congratulations once again, GM, though maybe for the last time. Your team's owner has just granted you a 1 year reprieve in the hope that your second year will be better than your first. You aim to take full advantage of the opportunity to give the fans what they want and so, prior to the coming season's spring training, you wisely trade away a future round draft choice and undisclosed sum for COIs, MOEs, and MOPs. In doing so, you've set course for a final scenario far more pleasing to everyone than the first two, and here's why.

You well know that your team's rabid fans feel the need for—that is, they identify the challenge of building—a "winning" ball club. Moreover, as shown in Figure 1, they may characterize "a winner" in terms of some number of critical operational issues—among them, a wish that their system of interest bring home a championship pennant or at least perform in a manner the fans could shamelessly claim to be "championship caliber." Because of the importance of COIs to stakeholder desires, when championship ways fail to emerge during the course of a season, fans are forced to admit that their beloved system simply didn't cut the mustard. In other words, they'd concede an unresolved COI and next demand improvement (or even wholesale replacement—including you, Mr. GM—if diehards get their way) during the ensuing offseason. Would fans know if their COIs, their "must-haves," had been satisfied? Moreover, would they be able to measure and thus recognize the "stuff of champions" hopefully displayed by their heroes? The answers to those questions are "Yes" and "Yes," and that's exactly where MOEs, MOPs, and Figures 2 and 3 come in.

Fans hoping to watch their club demonstrate championship play might quantitatively or qualitatively judge their team in terms of variable markers of baseball excellence (Figure 2), either quantifiable (runs scored per game, team batting

average) or unquantifiable (team chemistry). These would represent the MOEs by which fans could decide whether or not they've given their allegiance to a championship caliber ball club. Should a season of play yield a high average number of runs scored per game, an infield's worth of Golden Gloves, or a palpable sense of team chemistry, even the most ornery fans must concede that they had and adopt a "wait 'til next year" attitude. In such cases, fans would have seen the "proof in the pudding" of their MOEs, that pudding being the end product of individual recipe ingredients—the personal or team-wide stats that would be MOPs—smoothly blended to deliver a desired result.

Quite unlike the MOEs that should be viewed as variable, sliding-scale standards oriented toward stakeholder perspectives of goodness or desirability, MOPs should be treated as the points on such scales at which stakeholders may determine how good or desirable might be the outputs of their system of interest. The fans of a particular team, then, should view outputs such as "starting line-up," "strength of schedule," and "opponent" as precisely the sorts of performance evaluations they could use to judge team effectiveness against established standards, or MOEs (Figure 3). In doing that, they would have employed MOPs in concert with MOEs to determine, in strict "thumbs up" or "thumbs down" fashion, whether their team had displayed the stuff of champions and consequently resolved a critical fan issue.

Play Ball!

It's easy to see, Skipper, why you could have been seduced by readily available and appealing MOPs; and just as easy to see why, therefore, you built your first-year team from the bottom

Figure 2: MOEs Derived from Baseball Fans' COIs

The Problem:
A baseball team's rabid fan base wants "a winner."

COI₁
Has our team won the championship or has it at least displayed the "stuff of champions"?

COI₂
Another possible critical issue...

COI₃
Another possible critical issue...

MOE Runs scored per game

MOE Team batting average

MOE Team chemistry

MOE Another possible MOE...

MOE Another possible MOE...
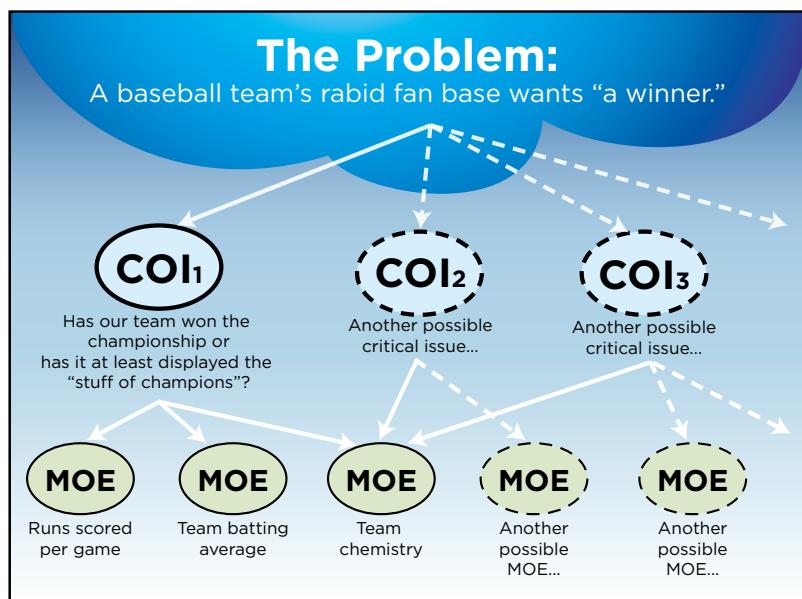
Figure 3: MOPs Selected for Evaluation against Baseball Fans' MOEs

The Problem:
A baseball team's rabid fan base wants "a winner."

COI₁
Has our team won the championship or has it at least displayed the "stuff of champions"?

COI₂
Another possible critical issue…

COI₃
Another possible critical issue…

MOE — Runs scored per game

MOE — Team batting average

MOE — Team chemistry

MOE — Another possible MOE…

MOE — Another possible MOE…

MOP — Starting line-up

MOP — Strength of schedule

MOP — Opponent

MOP — Another possible MOP…

MOP — Another possible MOP…

Building a baseball team and meeting a systems acquisition need should each be largely pursued as a top-down endeavor. In no other way will the desires of "fans" or other stakeholders gain the prominence due them. To build a team of champions, look beyond home runs. If you don't, you'll lose sight of the equal merits of a strong bullpen. Likewise, you can't meet the command and control (C2) desires of a security force by focusing too strictly on, say, unmanned surveillance vehicles, because, valuable though they are, these glamorous assets represent only a fraction of any C2 equation. You, Mr. or Ms. Acquisition Professional, like your cousin who manages in "the bigs," must think top-down and act on measurement schemes that are top-down—never bottom-up.

So play ball and play it well. Like the GM of this article who yearns to serve his team's fans to the best of his ability, acquisition agents need to always bear in mind the criticality of what they do to those they serve. Remember that for those hoping the agents' products will do what's needed, it really "ain't over 'til it's over."

Acknowledgement

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up. The team's owner recognized this, recognized the merits of giving to you the same sort of coaching you typically afford your players, and consequently put you back in the saddle for at least one more season. So don't blow it!

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Meeting Challenges Across Defense and Beyond

Energetics R&D in Systems Engineering

Dennis M. McLaughlin

When U.S. Marine M1A1 tanks advanced on Basrah International Airport on March 21, 2003, the defending Iraqi T-55 tanks didn't have a chance. The U.S. tank was built to outrange opposing armor. It is enabled by a high-density, chemical propellant. Each grain is uniform, with measured holes, allowing more surface combustion, and energy release. A 120mm cannon, built for high pressures, focuses this energy, propelling a round down range.

At the center of the M1A1 tank's design was energetics R&D—the study and use of materials for explosives, propellants, and pyrotechnics. It was part of a systems engineering process that made U.S. weapons unequalled in war. In the Cold War's aftermath, this process became less focused and this R&D became an afterthought. Today, energetics R&D, integral to a systems engineering process, is needed more than before—and not just for developing munitions. Tomorrow, it will be vital to helping America meet a multitude of challenges.

It bears reminding that one of the core functions of the U.S. military is to fire on targets. For more than a century, energetics R&D helped do just that. From R&D, begun before World War II, came deck-piercing bombs that destroyed enemy ships at Midway; Naval gunfire that devastated beach defenses enabling amphibious assaults; and antiaircraft rounds with proximity fuses so lethal that the Japanese adopted kamikaze tactics.

Energetics scientists and engineers were part of a process. In developing such munitions, they worked with developers of guns, ships, and aircraft delivering them. And in the late 1940s, systems engineering emerged. It brought all key players together to design more complex systems, like missiles, with energetics R&D taking center stage. It developed a grain propellant—a hardened aluminum and gum slurry mix—for Polaris missiles, transforming submarines into strategic-launch platforms. Across defense, this R&D developed warheads, propellants, and fuses around which other missiles and launch platforms were built, ushering in the "missile age."

McLaughlin *is the Technical Director at Naval Surface Warfare Center Indian Head Division.*

But in the 1990s, "the practice of systems engineering became increasingly fragmented within DoD," according to Defense Acquisition University's Mary Redshaw. It was not guided by military standards, but by "proliferating industry standards, process improvement frameworks, and organization specific guides and handbooks." And energetics R&D in weapons development occurred on a fragmented, rather than systematic, basis. Too often, it was an afterthought, providing the explosive "goo" in a weapon after development, as one defense official put it.

Energetics R&D, in a sound systems engineering process, is needed more than ever before. This approach is critical to meeting many combatant commanders' urgent operational needs. It will be vital to achieving future capabilities, such as those prescribed in joint operating and integrating concepts, guiding force development over 8–20 years. In just three—Major Combat Operations, Global Strike, and Joint Urban Operations—this R&D is directly relevant to 100 future capabilities and indirectly to more.

Increasingly Wanted: Specialized Munitions—Fast

In 2006, U.S. Central Command had an urgent need. It sought a low-collateral damage munition for use against insurgents, engaging coalition forces, from positions near schools, hospitals, and religious buildings in Iraq and Afghanistan. The need demanded that Air Force energetics experts help reengineer the small diameter bomb system. They developed a multiphase blast explosive. A composite carbon fiber case was also developed. The result was the focused lethality munition, with a more intense and lethal near-field blast but less fragmentation.

That's just one of the many specialized munitions warfighters have sought in recent years. Increasingly, warfighters want weapons that do more, go more places, and go further. That's especially the case with target effects. Traditionally, munitions were designed mostly for the destruction of personnel, vehicles, and structures. Today, warfighters need such tailored target effects as:

- Increasingly less collateral damage
- Greater and more visible target destruction
- Destruction of increasingly hardened targets
- Shoulder-launched weapons that can take down a building
- Controlled kinetic energy for non-lethal projectile delivery
- Direct fire, multipurpose munitions with programmable target effects
- Reduced environmental impacts
- Destruction of in-flight missiles and rockets
- Destruction of chemical and biological agent storage facilities without dispersing agents

And warfighters need these specialized munitions fast, requiring all systems engineering aspects present at creation. The focused lethality munition went from concept to delivery in 18 months. For the thermobaric munition, designed to attack insurgents in deep, winding caves, it was 67 days.

Achieving such specialized target effects requires energetics experts, informing systems engineering. They must analyze the target and develop energetic materials for intended effects. For example, naval energetics experts determined that high explosives cannot destroy stored biological agents. High explosives lack the heat to burn off biological agents, and shock pressures can disperse any remaining agents. Thus, they developed an effective agent-defeat munition that produces flame temperatures above 6,000 degrees F for minutes. The munition was then engineered for air delivery.

Munitions for extreme environments also demand specialized energetics R&D. "The option to deploy weapons in space," proposed by the 2001 U.S. Space Commission and others, would need unique conventional explosives and propellants. The Navy's Anti-Submarine Warfare Concept of Operations for the 21st Century calls for "greater numbers of enemy submarines destroyed per unit of time," requiring undersea weapons that produce specific shock effects, which others try to counter in submarine design. Increasingly deeper and hardened targets require munitions that can survive high-speed delivery temperatures, impact, and sense when to detonate inside structures.

And all want more range—largely a propellant and systems engineering issue. To increase U.S. 81mm mortar ranges for Afghanistan, energetics experts couldn't just add more old propellant. The increased pressure and erosion in the mortar tube would reduce service life. Instead, they formulated a nitramine propellant, producing initially lower, but longer combustion. Therein is the lesson: greater ranges require new propellants and systems that can accommodate them. Now consider the 2010 Quadrennial Defense Review seeks to "Expand future long-range strike."

History, too, must repeat itself. The first bomb dropped by manned aircraft was a grenade. It happened Nov. 1, 1911, in a war between Italy and the Ottoman Empire, when an Italian pilot attacked a Turkish camp in Libya. It marked the start of a developmental quest for aerial bombs and their delivery aircraft.

That must now extend to unmanned systems. To date, existing weapons have been used to arm unmanned systems, such as Hellfire missiles on unmanned aerial systems, and M249 machine guns for unmanned ground systems. However, DoD's FY2009–2034 Unmanned Systems Integrated Roadmap envisions "a proliferation of unmanned systems conducting force application tasks," to include:

- Air-to-air combat and suppression and defeat of enemy air defense
- Dismounted offensive operations, and armed reconnaissance and assault operations

In 2006, U.S. Central Command had an urgent need. It sought a low-collateral damage munition for use against insurgents, engaging coalition forces, from positions near schools, hospitals, and religious buildings in Iraq and Afghanistan.

- Mine laying and mine neutralization missions in the maritime domain.

Being smaller than manned systems, unmanned systems must have smaller, lighter weapons that can punch above their weight. Such weapons will be needed especially for Unmanned Combat Aircraft Systems, planned for suppression/destruction of enemy air defenses and penetrating strikes. Designed as a low-observable, it must carry and launch weapons from inside the aircraft, as carrying them externally will make them more observable. Such weapons will require a concerted energetics R&D and systems engineering effort.

Faster Logistics
Previously, munitions were shipped in a "box in a box," varying in sizes and shapes. Naval energetics engineers designed a "joint modular intermodal container," holding what seven pallets once did, with a uniformity allowing more efficient storage and transfer. The Defense Distribution Depot-Kuwait's first use of the containers reduced container handling by 23 percent in line-haul to Iraq. U.S. Transportation Command's evaluation found the containers reduced air pallet requirements by 32 percent and sorties by 25–50 for C-130s and by 7–14 for C-17s.

Energetics R&D impacts logistics. Working with logistics managers, energetics experts can develop ways to expedite the load. Such was the case with Joint Modular Intermodal Container which was part of a U.S. Transportation Command initiative to speed intermodal transfer. Working with systems engineers, energetics experts can lighten loads, which can help get material to the fight faster. It can also make a difference in how our forces fight.

Navy plans for the future CVN-78 carrier call for an increased sortie rate of 160 aircraft per day, compared to the USS Nimitz's 120. Thus, aircraft must be armed faster. Yet bombs have to move via elevators from below-deck magazines to flight deck "bomb farms," limiting their numbers. The bigger the bombs, the fewer moved in a given period. Smaller yet effective bombs would allow greater numbers to be moved, and thus arming more aircraft in a given period.

Major logistics and warfighting enhancements can come from energetics R&D for the grassroots level of war. In Afghanistan, the Taliban engage from higher terrain, knowing heavier U.S. forces have difficulty moving against them. A U.S. squad assault weapon gunner, for example, carries a 17.5-pound weapon and likely 1,000 rounds, weighing 33.8 pounds. Total load may be 130 pounds. "Added weight and thermal loading make Marines less effective in combat," according to Brig. Gen. Francis Kelley, commander of the Marine Corps Systems Command.

The Army's Lightweight Small Arms Technologies program portends the future. It is testing not only a 9.2-pound squad assault weapon, but also 40 percent lighter and 12 percent smaller polymer cased ammo. For a warfighter, 1,000 polymer-cased rounds weigh 21.7 pounds, a savings of 12.1 pounds. For a brigade combat team, it's estimated that polymer-cased ammo provides a 2-ton weight savings. Similar energetics R&D initiatives could reduce other infantry munitions' sizes and weights, providing significant weight reduction across ground units.

More Than Munitions
In Iraq, Marines used a system that x-rayed large containers, such as 55-gallon drums, to detect improvised explosive devices (IEDs). Wherever found, explosive ordnance teams often dispatched camera-carrying robots that more closely assessed, handled and even neutralized IEDs. On-scene EOD teams could also reach back to a help desk in Indian Head, Md., getting technical assistance on an IED and its possible neutralization. All these were enabled by energetics experts.

Countering explosive threats requires energetics R&D. It can develop detection means, working with intelligence agencies to target threat materials requiring detection. For example, 80 percent of IEDs use certain homemade explosives; this informed energetics experts' development of lightweight kits, which detect these homemade explosives in seconds.

Energetics R&D can also inform intelligence, as well as, systems engineering. To some intelligence analysts, another nation's development of a low-signature propellant may seem

insignificant, but to energetics experts it means launching missiles will be harder to detect, thus leading to improved detection systems.

And informed by intelligence, energetics R&D can aid in engineering countermeasures, which is part of a deadly and never-ending contest. Modeling of known undersea threat explosions is used in U.S. ship and submarine construction. Knowledge of threat energetics also informed the engineering of ballistic protection for mine resistant ambush protected (MRAP) vehicles, including V-shaped hulls for deflecting blasts.

Today and more so in the future, energetics R&D is needed to develop other countermeasures. That's especially the case with traumatic brain injuries (TBIs); more than 150,000 U.S. military personnel have suffered TBIs since 2000, most caused by blasts. Energetics expertise is informing medical research on blast-induced brain injuries. It also can inform the engineering of vehicle and helmet countermeasures. Energetics experts have already developed tiny, unpowered sensors which could detect blast pressures causing brain injuries. Such detection could allow medical personnel to arrest brain cell death with serums and other means.

Additionally, energetics R&D is needed to develop and engineer detection and countermeasures in homeland security, as well as, defense. Just one example is the "Standoff Technology Integration and Demonstration Program," being conducted by the Department of Homeland Security. It seeks the prevention of explosive attacks at large public gatherings such as conventions and sporting events.

Ready or Not …

Energetics R&D is not static. In its 2004 report, *Advanced Energetic Materials*, the National Academy of Sciences (NAS) stated, "Many emerging technologies show promise for revolutionary changes. Realizing this revolution will not be achieved by energetics R&D working alone or even as afterthought. This revolution will depend on energetics R&D driving systems engineering."

As mentioned, increased ranges may be enabled by advances in propellants such as "high nitrogen compounds" and "azido-energetic thermoplastic elastomer polymers." However, referring to the needs for greater range, lethality and more, the NAS also reported, "Advances in propellants alone cannot meet all of these needs. There must be synergistic design of the barrels, breaches, recoil systems, munitions, and propellants."

The greatest change may come from nanotechnologies, notably "nano-energetics." Still in its early stages, this technology is already among us in devices like the iPod and portends change in almost every industry. It is likely to change warfare as well. Nano-energetic materials, 500 times smaller than a human hair width, will be more powerful than micron-size material, having quicker ignition and larger energy releases. In *The Impact of Nanotechnology Energetics on the Department of Defense by 2035*, Col. Ancel Yarborough, USAF, wrote:

> By 2035 nano-energetics will have advanced to replace current explosive materials and systems designed to deliver them. They will provide the explosive power of current conventional weapons at up to two orders of magnitude less overall mass. Weapons designers will capitalize on the molecular interactions that can be carefully constructed from the bottom up in combustible nano-materials, and a new class of very small, extremely lethal weapon system will emerge.

The race is on for energetic advances. Nations such as France, Germany, and the United Kingdom have ongoing energetics R&D programs and since the 1990's, Russia's program has been especially vibrant. "The number of people doing energetics science and technology in China is at least two orders of magnitude larger than what we have here in the United States," estimated James M. Short at University of Maryland's Center for Energetics Concept Development.

The Greatest Challenge

In the Cold War, energetics R&D, in a systems engineering process, provided U.S. forces with technological advantages. This approach was very focused and when the Soviet threat went away, it became less so. That must change. Today, "this is the Blizzard War," stated Secretary of Defense Leon Panetta, "a blizzard of challenges that draws on speed and intensity from rapidly developing technologies." Energetics R&D in agile systems engineering efforts across DoD and beyond will be key to meeting this blizzard—and America's greatest challenge: uncertainty.

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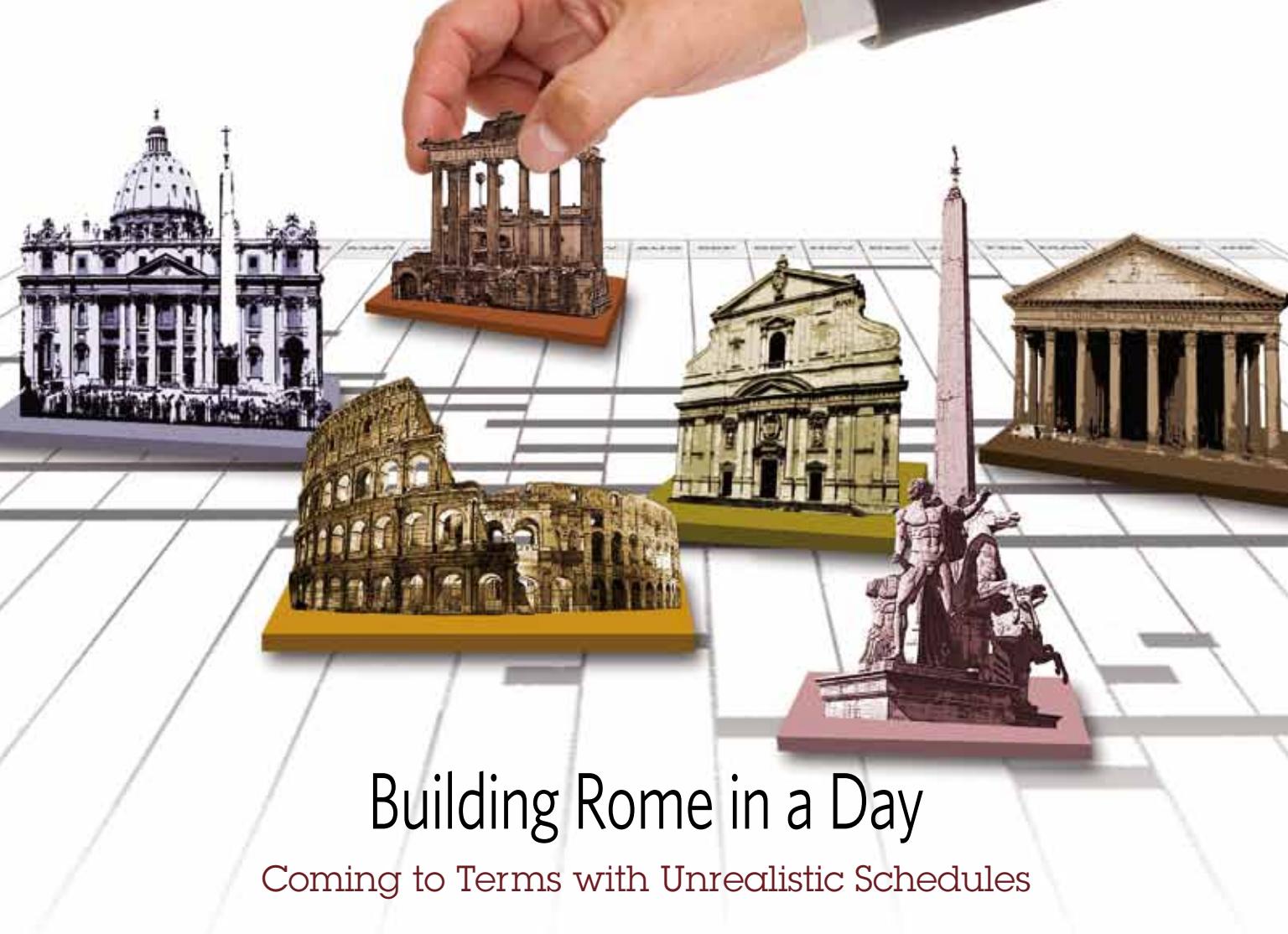
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Coming to Terms with Unrealistic Schedules

Lon Roberts, Ph.D.

Among the fragments in his personal notes, American poet Theodore Roethke lamented that "What we need is more people who specialize in the impossible." One wonders if Roethke might have felt compelled to jot down this statement on the heels of being reminded for the umpteenth time that "Rome wasn't built in a day." We may never know for sure, since Roethke died in 1963, but his remark speaks for all who have experienced the frustration of having to deal with those who use this cliché as justification—or an excuse, if you will—for why things take as long as they do.

When the question of "Why did we overrun the schedule?" comes up in project post-mortem analyses, there is at least one response that is predictable: "The schedule was unrealistic to begin with." Problem defined, root cause identified, on to the next issue!

Of course, there truly is such a thing as an unrealistic schedule, but to discern whether this is a legitimate explanation or an excuse for poor performance it is necessary to determine if the conditions were such that a schedule overrun was inevitable. After more than 20 years of paying attention to this phenomenon, I am convinced that

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conditions are to blame in the majority of cases—at least 80 percent of the late projects I am personally aware of. In other words, except for the occasional project schedule that is truly unrealistic under the best of circumstances, it is often the case that what gets pegged as an unrealistic schedule might be labeled otherwise if the system were more accommodating—that is, if the conditions were different. As obvious as this may seem from the stratosphere looking down, consider the fact that the solution to the "unrealistic schedule" problem on the tarmac is typically met with a request for more time, rather than suggestions on how the system might be altered to accommodate the schedule. There seems to be a tacit assumption that if a project schedule is judged to be unrealistic given the circumstances, then that's the end of the story; the circumstances are immutable.

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Entertaining the thought that the system might be made to conform to the schedule, rather than the schedule to the system, requires a bold leap in and of itself. But making the impossible possible starts with something even more fundamental, more intangible, more deeply rooted in the human spirit than this. It goes by different names and because it falls within the realm of what some disparagingly refer to as "touchy-feely" and can't be depicted as a bar on a Gantt chart, it often gets downplayed or simply overlooked. Some call it "can-do thinking," and others refer to it as "possibility thinking." In a NASA report, *Shared Voyage: Learning and Unlearning from Remarkable Projects*, the authors describe this quality as the "will to win," and they place it at the head of a short list of critical success factors. But regardless of the label, it speaks to the importance of approaching time-critical projects with an attitude that "building Rome in a day" is possible—at least figuratively—if circumstances are alterable. Furthermore, the potential to accomplish remarkable projects is more likely when everyone is on board with this philosophy. The authors of the NASA report had this to say about that: "In the highly demanding and dynamic project environment, leaders encourage even their contractors to adopt a will to win by challenging the status quo."

But the status quo hasn't earned the reputation for being the obdurate force it is by being an easy mark for change.

And its intransigence is aided and abetted by what I call the "800-year-old excuse"—an ancient premise, with a contemporary pretext, that has persisted to the point that it appears to have become lodged in our mental DNA.

The 800-Year-Old Excuse
The "Rome wasn't built in a day" phrase is thought to have originated in the late 12th century. If so, humans have relied on this comeback for over 800 years as an excuse for why deadlines and other time commitments have not been met. The phrase may indeed be a cliché, but to endure since the Dark Ages, it apparently communicates something that is universally understood. If so, what might that be?

On its surface, "Rome wasn't built in a day" appears to be an innocuous metaphor for stating the obvious: a genuine work of quality takes time. But in the subterranean world of veiled threats, the user of the cliché may have something more sinister in mind. Without saying so explicitly, he or she may be challenging the person to whom it is directed to answer this gotcha question: "Do you really want to be responsible for cutting corners on quality, despite my objection to doing so?" After all, if quality is compromised and problems later arise, all fingers will likely point back to the corner-cutting decision maker. There is nothing more immodest than a naked decision!

But there is a fundamental flaw in this line of reasoning, especially in circumstances where rapid results are important. In situations such as these—when time is of the essence—time itself is a value-added quality attribute, much the same as any other quality attribute. It is not simply a constraint to be monitored, managed, and worked within or around. Furthermore, in the fast-paced, technology-centric world in which we live, the quest for rapid results is not limited to crisis situations; it is increasingly becoming the norm rather than the exception. For instance, in the day-to-day world of industries that compete on the basis of time-to-market, a perfectly designed generation-A product that's late to market will likely be rendered obsolete well before its time by a less perfectly designed generation-B product from a competitor. An analogous statement might be said about systems that are critical for military readiness, though the stakes are considerably higher and the enemy is not bound by any standards of fair play.

The Power of Irrational Exuberance
Coupled with a willingness and ability to reengineer the project environment, a can-do attitude serves as the catalyst for taking on what might otherwise be deemed as an unrealistic schedule—and in a figurative sense, flipping the "Rome wasn't built in a day" platitude on its head. In slightly different terms, it is the place where the spirit of can-do determination intersects with the system's capacity to do what needs to be done. Critics may regard it as "irrational exuberance," but the facts tell a different story. Besides, "irrational" is a subjective term at best.
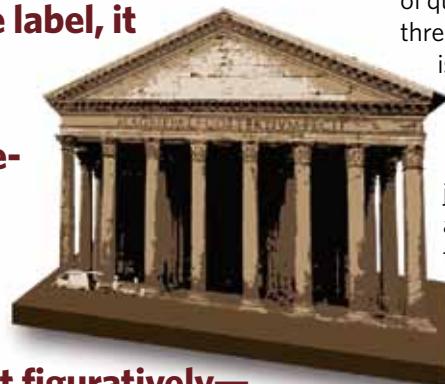
An early example of the power of what may have appeared to some as irrational exuberance is the first Transcontinental Railroad—now considered to be the greatest technological achievement of the 19th Century. Inspired by the can-do leadership of President Lincoln—a man who also knew a thing or two about making a compelling case—this massive undertaking was launched in 1862, at a time when the American Civil War was going strong, resources were scarce, and the hearts and minds of the American people were focused elsewhere. Despite a costly war, the assassination of a president, brutal weather conditions, rugged terrain, and even a self-defeating system for compensating contractors, this 1,777-mile megaproject was completed in 1869, less than 7 years from start to finish!

A more recent example is the P-51 Mustang fighter airplane that played a pivotal role in the Allies' success in winning the air war over Europe in World War II. Compelled by the pressure of war, in 1940 the British government awarded a contract to the American company, North American Aviation (NAA), to design and build a prototype of the P-51 on the seemingly unrealistic schedule of 120 days. Despite the circumstances—technical, political, cultural, and logistical challenges—NAA rose to the occasion and delivered the prototype 117 days after the contract was awarded! It was a feat that an article in the July 1943 edition of *Popular Science* would later describe as "building a ship that would be a full year ahead of its time when it first saw action."

Though the P-51 is best remembered for its success as both a bomber escort and an attack aircraft in WWII, project managers and mission directors would do well to learn from the P-51's rapid design and development. One of the most important lessons is reflected in the words of the president of NAA at the time, Dutch Kindelberger. In his appeal to grant his company the opportunity to design and build the P-51 prototype—in lieu becoming a mass-production facility for the Curtiss P-40, a plane in service since 1938—Kindelberger told the British, "I can build you a better airplane, and I can build it fast." A pretty gutsy claim considering he had no detailed drawing or plans at the time!

There is no record I am aware of that hints at the degree Kindelberger's tone of voice or body language may have played in convincing the British. But given that he was an engineer and not a thespian, we can be pretty sure that they believed that he believed what he said was possible. Furthermore, by virtue of his position in the company he was able to take a leadership role in transforming a system that till then had been in the business of mass-producing a trainer airplane into one that was up to the task of creating a prototype for new high-performance fighter plane—and to do so given an unrealistic schedule.

Reframing the Solution

These projects and others like them that are open to scrutiny—such as the NASA missions deployed in the 1990s utiliz-ing the Faster, Better, Cheaper (FBC) approach—tell a story about the potential of can-do thinking. But can-do thinking is a state of mind, an attitude, a willingness to buck the tide that must be accompanied by bold actions. After all, conventional practices are destined to deliver conventional results—not a rosy prospect considering the low percentage of projects that are completed on time and within budget using conventional project management processes and tools.

On a personal note, this unsettling reality led me on a quest—around the time NASA adopted the FBC approach—to discover if the lessons learned from reducing the cycle time of business processes could be brought to bear on projects and the project environment. From a practical standpoint, I discovered that the "start with a blank sheet of paper" paradigm did not work well for processes or projects, although it was (and continues to be) helpful in visualizing what might be possible if circumstances were ideal. And as systems guru Russell Ackoff rightly pointed out in his book *Idealized Design*, "When we change our point of view and look backward at where we are from where we want to be, in many cases the obstructions disappear."

Making the obstructions disappear doesn't require starting with a blank sheet of paper, but any truly ambitious assault on

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project cycle time does require a willingness to examine every aspect of the system—up, down, inside, and out—that directly or indirectly influences the way projects are planned, led, and executed. In other words, it requires a willingness to reframe our thinking about the project framework and then exercise the courage to go the next step and actually remove the barriers. It requires organizing the system around the schedule, and not vice-versa.

As long as we don't succumb to the "Rome wasn't built in a day" attitude, there is hope for winning the war against the unrealistic schedule. It is a war worth waging!

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What Does it Take for Social Software to Succeed in DoD?

Brian Drake

ow many of us have been faced with this situation?

A budding DoD executive pops into your cube and says, "Hey, I heard about this thing called Pinterest. I went on it last night and I thought it was really cool. I think we need Pinterest for the office. Will you help me?"

If you're not stunned by the suggestion, you'd probably respond by saying, "What's Pinterest?" And you wouldn't be alone.

Across the federal government, departments are diving into social software solutions for all sorts of mission needs. Some of those installations are screaming successes that are praised inside and outside of government. Others are

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miserable failures that have program managers of all stripes cursing the names of Jimmy Wales and Mark Zuckerburg.

Some of the successes are a confluence of luck, timing, and the presence of talented people who care enough to make the initiative succeed. The failures share common short-comings in programmatic control, project design, and procurement strategy. Navigating this minefield can be a frustrating experience that few wish to replicate. Those who know how find that the return on investment far exceeded expectations. In a hostile budgetary environment, selecting the right solution for your organization has never been more important.

I have been intimately involved in two enterprise-wide social software (otherwise known as Enterprise 2.0) implementations. One was A-Space, also known as the "Facebook for Spies," for the Office of the Director for National Intelligence (ODNI). The other was D.Wiki, which I founded while employed at Deloitte Consulting. Both programs generated significant gains for each organization but left many outsiders asking, "How did you do it?"

Aside from having some of the best leaders, partners, and social software evangelists in the business to work with, we followed a few guideposts for effective program management. These are just a few suggestions on how to implement your own social software solutions for the DoD.

The Mission Always Comes First
No matter how exuberant that budding government executive in your cube is, you need to ask a set of probing questions to define and scope the effort.

- What's the problem you're trying to solve?
- Who else agrees with your view of the problem?
- When does the problem need to be solved?
- Why hasn't anyone taken action to solve the problem?
- How does social software address the problem?

Some of these are just good program and procurement planning questions. More importantly, they attempt to throttle back the raw, sometimes counterproductive, excitement that Enterprise 2.0 solutions have generated across the DoD. Too often the novelty of a new software solution overwhelms the principal responsibility of every procurement professional; pro-

tecting taxpayer interests. Be prepared for the government executive clutching her or his copy of *Wikinomics*, citing studies about the miracle of crowdsourcing, and the value of social software realized by skeptical businesses.

No doubt there are many case examples of businesses and government agencies that overcame tremendous psychological and organizational barriers to achieve unrealized gains. In each of those examples, easy answers could be supplied to the questions above. If they can't be supplied in a 5-minute conversation with the customer, then some more research needs to be done.

Defining Success
Too often Enterprise 2.0 ventures fail because no one spent the time to think through, describe, and document what a successful social software program looks like for their organization. Ask yourself or the prospective program manager:

- What do you consider to be mission success for this problem?

If this answer is not readily apparent, ask:

- Who determines what constitutes mission success?
- What would they say forward progress looks like?
- When would one expect this goal to be reached?
- How is your solution less costly, improve efficiency, or appreciably increase the quality of service delivery compared to other options?

At the outset, you and your customer may not have the answer to these questions. That's okay. Consider this list a step toward establishing a baseline of expectations for the program. It assists with being able to identify tangible and intangible successes for the program. If the answers are held by higher management, don't be afraid to ask them for help.

Preparing for Success
Every effective program, whether it's building an aircraft carrier or buying a desk, starts with a set of clear requirements. Many DoD contracting officers and representatives are familiar with the axiom "garbage in, garbage out." This is especially true when seeking any custom or off-the-shelf software solution.

Software is one thing, but what puts the "social" in the software is people. Getting the right mix of people to build your collaborative community is perhaps one of the most overlooked requirements to keep a collaborative ecosystem vibrant. On the A-Space program, I managed a team of five consultants to assist users with crowd building, collaboration techniques, and simple technical support issues. Beyond the mechanics of their day-to-day operations, the A-Space Analytic Support Desk (ASD):

- Gave users the ability to reach out to complete strangers that worked in one of the other intelligence agencies,
- Closely communicated with users on their technical issues and sought speedy solutions,
- Shared and helped implement practical collaboration strategies for intelligence analysts,
- Assisted in notifying supervisors of significant mission accomplishments made by their analysts,
- Captured new user requirements based on shifting mission priorities, and
- Identified and warned of system problems before normal users became aware of a problem.

The ASD had many responsibilities, but implicit amongst them was instilling confidence in the user base. The ASD became the "canary in the coalmine" when the system was experiencing some early growing pains. They communicated, at an interpersonal level, the value of the system to the workforce and gave the users a reason to keep coming back. Unlike a traditional IT help desk, whose primary metric is how fast it can close a ticket, the A-Space ASD treated every encounter as an opportunity to learn from users. The longer you had them on the phone and talking about their problems, the better. This personal touch paid huge dividends to the A-Space program in terms of data collection, customer service, and, most importantly, user adoption.

Measuring Success
Metrics make or break an Enterprise 2.0 effort.

Taking the necessary steps to define and prepare for success are irrelevant if you can't generate credible, defensible data to win out-year budget battles. That's when a relentless metrics collection activity pays off. For the A-Space program, success was defined by mission outcomes driven by intelligence

analysis. This broad definition of success guided the selection of some near-term, mid-term, and long-term goals for the program. Progress against those goals was tied to a metrics program that measured any number of factors including membership, collaborative activities, and other key indicators of mission accomplishment. The A-Space team also collected a library of anecdotal success stories to illustrate how the intelligence mission was being improved through collaboration. This time-intensive effort made the job of the ODNI's senior executives infinitely easier when it was budget justification time. Better still, because A-Space was such a raging success, ODNI leaders were able to use short, meaningful statistics or high-impact anecdotes to quickly illustrate A-Space's value to skeptics.

At Deloitte, I witnessed the enterprise struggle with how to collaborate in an increasingly connected and information-rich environment. Deloitte views collaboration among its employees as its competitive advantage. With a mobile workforce of over 150,000 employees globally, a robust technical collaboration solution was essential. Many information technology platforms were considered and beta-tested. Among those that were officially accepted by the Global Deloitte Firm was D.Wiki. Based on free, open sourced software, D.Wiki began as a method to broadly share information about firm activities, accounts, and best practices. The D.Wiki team collected a series of metrics on user activity and success stories. While Deloitte's D.Wiki program ultimately defined success through the lens of profitability, there were several key collaboration metrics that served as surrogates for profit. Increases in membership, number of page views, number of edits, and the number of communities of interest became the hallmarks of success for the program. Within 3 months of D.Wiki's implementation, the system had more views than all of Deloitte's internal collaboration websites combined. Within 2 years, D.Wiki amassed more than 11,000 users, 113,000 edits, hundreds of communities of interest, and over 1 million page views. This degree of success made an $8,000 program into a $200,000 global, firm-wide investment. None of that program growth would have been possible without metrics.

So What Makes Social Software All that Different?
That young, overly excited executive is still standing in your cube.

If you select low-interest mission tasks, it is less likely to achieve its intended goals. Moreover, if you choose a high-impact mission with tedious tasks, the crowd you need will not follow.

You've listened to an hour of her/him blather on about the "wisdom of crowds" and retweeting the latest Lady Gaga single. You're about ready to permanently "unfriend" her/him. You only hope that she/he has heard some of your advice on how to shape the program. Still, you may be wondering why an Enterprise 2.0 solution poses any real unique challenges.

Simply put, every social software solution entails a higher degree of programmatic risk than what we have ever experienced in the procurement community. In a traditional weapon system build, there is a designated prime contractor and at least "one throat to choke." In a crowdsourced solution, no one and everyone is responsible for the mission outcome. This makes it extremely difficult for a program manager to use contract clauses or funding levels to entice the contractor to perform. An Enterprise 2.0 program manager must learn the art of collaboration, the incentives for swarming, and the contributing factors for knowledge discovery.

It is important to carefully select the mission that is best suited to a social software solution. This is somewhat of a catch-22 for the average government innovator. The programmatic risk inherent in Enterprise 2.0 ideas often relegates them to low-impact mission areas and predestines their failure. Exciting, difficult, and ambiguous mission problems benefit the most from social software because it emotionally engages and motivates the participants. That psychic energy builds momentum for the program and contributes greatly to the prospects of its success. If you select low-interest mission tasks, it is less likely to achieve its intended goals. Moreover, if you choose a high-impact mission with tedious tasks, the crowd you need will not follow. No one wants to work on a collaborative enclave that makes the tasking system more efficient. Everyone wants to work on a counterterrorism targeting project called "Facebook for Scumbags."

In the near future, we will have to come to grips with accepting more risk when it comes to purchasing software and services that support crowdsourcing. As the global marketplace diversifies and greater efficiencies are being demanded of our contractors, we should expect that they will use smart mobs to help meet DoD needs. Accepting that risk means we need to adopt program management strategies and practices that mitigate the adverse impacts of these risks.

For all the bluster and hype that Web 2.0 enjoyed in the mid-2000s, we still struggle with how the mission of the Department of Defense is better served by leveraging these technologies and ideas. Just like Deloitte, collaboration offers the DoD a competitive advantage over our adversaries. We would be foolish not to find every way possible to better discover information, connect with colleagues, and synchronize mission operations. Building this capability begins and ends with effective program management and procurement planning.

Managing O&S Costs

A Framework to Consider

Rear Adm. (Select) CJ Jaynes ■ *Tim Simpson* ■ *Duane Mallicoat*
James Francisco ■ *Worth Mizell* ■ *Daniel Cikovic*

For most weapon system program management offices (PMOs), dealing with cost, schedule, and technical trade-offs is a way of life. Although research, development, test and evaluation, and procurement costs tend to garner the attention, 60 to 70 percent of a weapon system's life cycle costs are associated with day-to-day operations and support (O&S) costs.

Therefore, in today's austere budget environment, it should also come as no surprise that a weapon system's day-to-day O&S costs are a major focus area for DoD acquisition program managers as one way to achieve cost efficiency.

A PMO's Challenge

With the requirement for DoD programs to become more efficient and more effectively use increasingly scarce budget dollars, maximizing affordability and productivity in defense spending is a must. Program managers must

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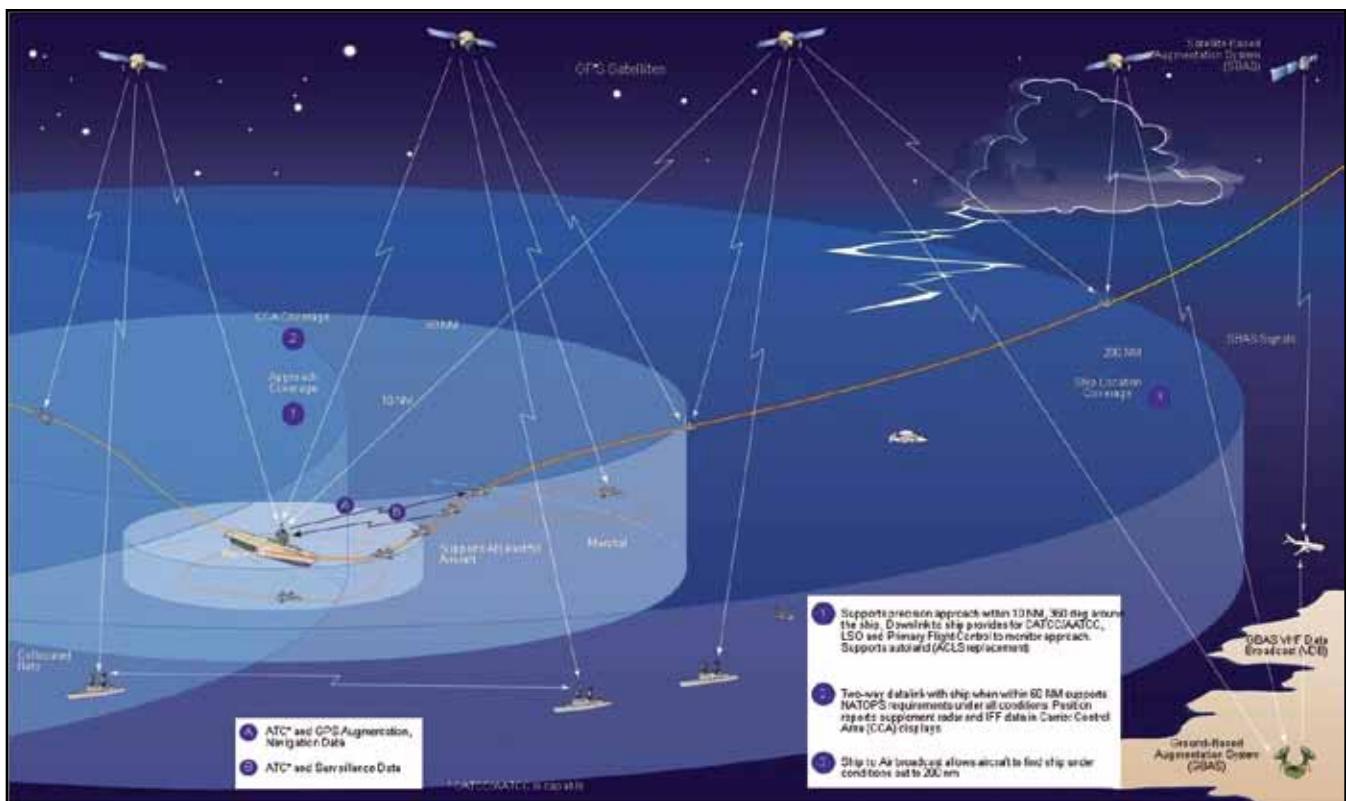
continually be able to defend whether their program is affordable. When answering that top-level question, a program will likely be asked to describe the guidelines used to determine the affordability question. When a program considers adding the next increment or adding an increase in capability, how are all of the cost-versus-technology trades made while keeping a focus on "out-year" sustainment O&S costs? In that light, PMOs must proactively plan every aspect of weapons systems acquisition—especially O&S costs, which are inherently the largest cost driver in the total ownership cost (TOC) equation.

All weapon system PMOs would like to continue to deliver technical improvements to meet a warfighter's original set of requirements. However, if a PMO is not diligent in following a well-defined, rigorous process to capture all impacts that result from incorporating a new "requirement," the PMO may overlook one or more factors that may cause major increases to a weapons system program's O&S costs.

So the challenge is whether your PMO has a disciplined approach to manage your program's O&S costs. And, if so, is your organization's approach dynamic enough to support all aspects of your program's O&S planning, to include the management of all technical improvements to your weapons system such as Engineering Change Proposals (ECP's) and/or increment upgrades?

PMA-213 Story
PMA-213, the Naval Aviation Air Traffic Management Systems PMO, is part of the Naval Air Systems Command (NAVAIR) Program Executive Office for Tactical Aircraft Programs (PEO-

(T)). Within the PMA-213 program portfolio, the Joint Precision Approach and Landing System (JPALS) program was established to develop a global positioning system-based system that provides a high level of accuracy in position and landing information. JPALS will initially be integrated onto aircraft carriers, L-class ships, naval aircraft, and ground-based landing fields to provide a survivable, all-weather, day/night precision approach and landing capability. The system is for joint Services both ashore, afloat, and expeditionary. The Navy is currently designated as the lead Service. JPALS Increment 1A (Sea-Based) is currently in the Engineering and Manufacturing Development acquisition phase.

As the JPALS program progressed through the acquisition life cycle, the program was being asked more frequently to ensure O&S costs were as fully captured as possible—and being managed. In order to accomplish this tasking, PMA-213 leadership recognized that any approach to capture this type of O&S cost information needed to be discernible at any stage of the JPALS life cycle, not just major events or milestones. An O&S picture needed to be available at a moment's notice to cover the multitude of a program's interactions ranging from planned major milestones and events to "what-if" drills.

An O&S Framework
In response to this tasking, the JPALS Team set out to develop an "O&S framework" methodology. In addition to drawing upon key elements from across the PMO, representation was also sought from NAVAIR 6.0 (Sustainment), NAVAIR 4.2 (Cost Estimating), and both primary industry partners (Rockwell Collins and Raytheon) to ensure the developed

framework achieved buy-in from the program's major stakeholder community.

The team's desired outcomes were to:

- Increase the level of cost detail (specifically out-year costs);
- Increase the level of confidence in the program's O&S estimates so that they could serve as a foundation for credible and defendable budget submissions;
- Establish a robust approach allowing for real-time cost-versus-technology trades;
- Effectively manage the O&S portion of the PM's TOC;
- Ensure that reliability, availability, and maintainability (RAM) as well as any program Key Performance Parameters and/or Key System Attributes were considered as part of O&S costs; and
- Adapt the systems engineering technical review (SETR) process to ensure that the O&S cost portion was included as part of the evaluation criteria.

The challenge for the team was to select some appropriate elements tailored to the JPALS program that would allow the program and PMO to manage the JPALS O&S costs. From a JPALS context, "manage" meant the inclusion of O&S estimates resulting from program milestone reviews, technical reviews, logistics reviews, etc., as well as potential impacts based on the incorporation of an ECP.

The framework used considered cost estimating rules based on the cost analysis requirements document (CARD) and Office of the Secretary of Defense's Cost Assessment and Program Evaluation (CAPE) O&S cost element structure as their initial guidance to determine how to tailor the JPALS program-specific cost elements. The CAPE's six major cost element categories include:

- Unit-Level Manpower
- Unit Operations
- Maintenance
- Sustaining Support
- Continuing System Improvements
- Indirect Support

While the CAPE's elements provided an O&S roadmap, the JPALS program wanted to fine-tune the CAPE elements to arrive at a set of "JPALS O&S cost elements" deemed by the JPALS program to be critical when attempt-

The O&S framework was invaluable in predicting the future costs, and identifying opportunities for improvement the team otherwise might not have looked at.

ing to track the impact of identified O&S costs and potential O&S cost changes.

The JPALS program also set out to formulate its O&S framework as a "living" tool applicable to any point in the JPALS acquisition life cycle. That is, the O&S framework being developed had to be more robust than simply capturing O&S costs as major program events, such as milestone reviews and technical reviews. The O&S framework tool being sought needed the fidelity to capture any potential O&S cost increases at any point along the JPALS program's acquisition life cycle.

After much deliberation, the team deemed 15 elements critical for JPALS to effectively and accurately track the program's O&S costs throughout the acquisition life cycle. (See Fig. 1.)

Figure 1. JPALS O&S Framework Cost Elements

Technical assumptions for sustainment (documented in each CARD and LCSP iteration)	Net cost of reparable replacement and unit cost of consumables at the O-Level	Supply Chain Management costs
OPTEMPO (op or flight hours)	Schedule maintenance labor and material	Software support
Anticipated life cycle to include demilitarization and disposal	Any applicable IMA repair labor and material replacement costs	Sustaining/In Service Engineering and program management costs after fielding
Iterative configuration managed architecture baseline	Tech Refresh to avoid DMSMS	Corrective ECP estimates beyond tech refresh
Maintenance/Failure calculations based on fielding plan	Depot costs beyond net cost for each DLR above (traditional or PBL based)	Anticipated technology insertion costs

Figure 2. Example of Sustainment Chart
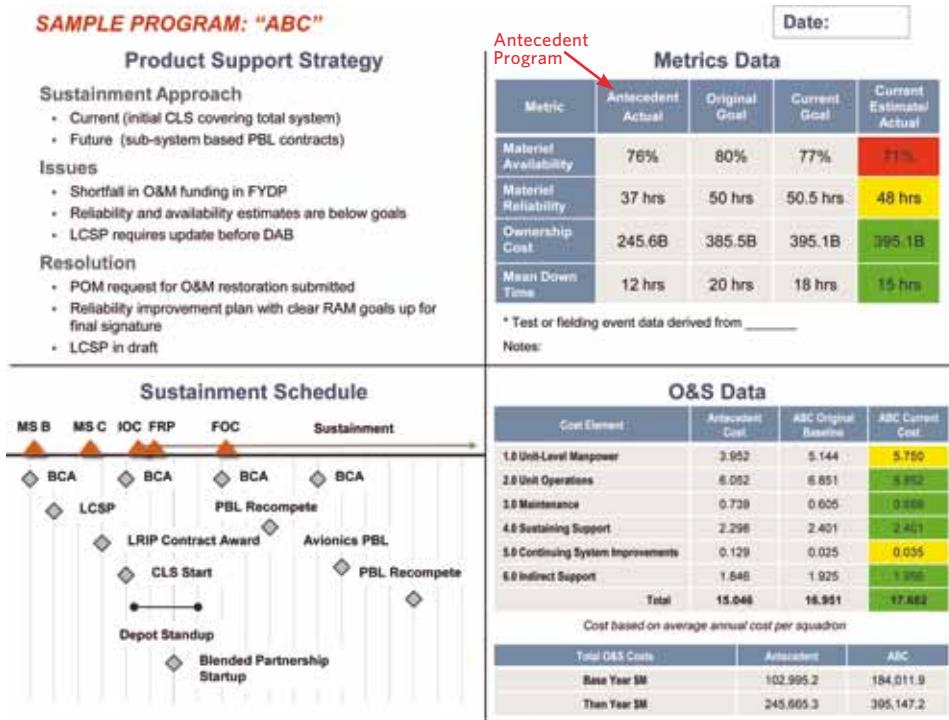
This is not to imply that all programs would arrive at the same 15 elements. PMs should apply critical thought and analysis to determine which elements best fit their particular program.

A Living Management Tool

The JPALS O&S framework can be viewed as a three-tiered approach. At the top tier are O&S cost estimates established at the major technical reviews. For example, an O&S cost is quantified at the preliminary design review (PDR), which is based on the allocated baseline architecture and planned sustainment strategy.

Subsequent to these major technical reviews are numerous middle-tier reviews focused on specific functional areas, such as systems engineering and logistics—for example, an initial operational capability supportability review (IOCSR) and full operational capability supportability review (FOCSR) for fielding decisions.

On a more frequent basis, the JPALS O&S cost estimates are addressed at the program's weekly "drum beat" program meeting to ensure that O&S costs, in general, stay in front of PMA-213 and JPALS leadership. The review of these and other technical assumptions and related costs are measured against each technical review baseline: functional (System Functional Review), allocated (PDR), and initial product (Critical Design Review).

Note that the categorization of specific reviews within the JPALS program's hierarchy should not be viewed as a review's level of importance. All reviews, regardless of where they may be slotted in the program's review hierarchy, are viewed as critical to an accurate O&S cost estimate, which is the primary purpose of the framework. To a large degree, a program's acquisition category drives the level and frequency of reporting with the goal of improving affordability fidelity, to include as early as possible in the development of a weapon system. However, the intent of the JPALs O&S cost estimate process is to provide a continuous improvement of performance and sustainment tracking to O&S requirements throughout the life cycle.

The JPALS O&S framework helps populate the O&S Data portion of the four-quadrant Sustainment Chart found in the *Product Support Manager (PSM) Guidebook* (Figure 2). The importance is that O&S Costs are one of our key Life Cycle Sustainment Outcome measures as shown in the Metric Data quadrant (upper right). In addition, O&S Costs are one of three Life Cycle Sustainment Outcome measures mandatory for Joint Requirements Oversight Council (JROC) interest programs with materiel solutions. Therefore, a program can start to now fully appreciate how critical O&S costs are to senior leadership and how a program's O&S costs can be used as a metric for the PSM to create an aligned product support strategy.

As the JPALS system architecture evolved, the program and sustainment assumptions and cost estimates were updated with continuous improvements or performance trades between the mission and sustainment systems. These were triggered to ensure both mission and support systems are optimized within performance and cost (affordability) parameters. Business cases were generated to continuously capture the performance within cost constraints as they evolve through development, T&E, and operational use. The PMO then used the O&S framework to provide future-year cost data estimates which enabled the PMO team to make informed technical and programmatic decisions on evaluation of system upgrade options.

Meeting the Objectives?

To answer this question, we will provide an overview of the JPALS approach. For Sea-Based JPALS (Increment 1A), it was applied after milestone B prior to PDR. The use of the tool bounded PMA-213's milestone B cost estimate in 2007 through December 2011, with a stable CDR and plans for mile-

stone C in May 2013. Use of the framework identified cost savings of over $100 million in O&S during the PMO design change process.

The JPALS Sea-Based system milestone B O&S life cycle cost estimate defined in the CARD and low fidelity cost assumptions were $331 million. Today it is $339 million. The PMO team was pleased with the results, considering the significant number of changes to the system design over the past 4 years. The tool was instrumental in analyzing low maturity cost areas and trades with performance and sustainment. The O&S framework was invaluable in predicting the future costs, and identifying opportunities for improvement the team otherwise might not have looked at. It took a creative, motivated team to accomplish it.

Examples of Success
Here are several examples of how the tool was used and the results achieved:

Remote Status Panel. Early in the development program the need for a Remote Status Panel was determined with $9 million cost grow recognized that included O&S. Using the O&S framework, the PMA-213 team sought an offset to keep cost stable. The design team honed the development cost. NAVAIR 4.2 honed their production using the Acqui-

sition Program Baseline (APB) cost architecture as a baseline to reduce Procurement Unit Cost (PUC). The O&S team found sufficient savings by improving material repair to offset the potential growth.

Data-link. During development, the data-link subsystem was assessed for achievable built-in-test (BIT) capability and it was found that the current support to meet the required performance requirement was inadequate and would require significant change to the design and potential schedule impact. The projected cost growth would add about $75 million to the O&S life cycle cost estimate in maintenance. Use of the tool ultimately provided options for the PMO that would realize cost savings in the amount of the projected O&S increase.

CARD Estimate Fidelity. The sustaining engineering cost estimate fidelity in the CARD for PMA-213 was higher than NAVAIR 4.2 had seen in any program at this point in the acquisition process—i.e., pre-IOT&E. Thus the tool allowed

a better understanding of the costs associated with technical design and production and their impact of O&S costs throughout the system life cycle. It also provided the PMO team the ability to highlight potential system improvement opportunities.

Challenges and Lessons
As with all processes, there are always challenges and hopefully some lessons learned. The O&S framework is no exception. Here are the key challenges that were faced by the PMA-213 PMO and some best practices that were realized.

Challenges:

• PMO Team (including OEM) lacked understanding of all the aspects that impacted Reduced Total Ownership Cost (RTOC) and how the O&S framework tool could be applied. This was a key aspect that had to be addressed before moving ahead to the development of the business cases and excel data base (basis of framework tool).
• Standardizing the process (specifically who would be involved and how the tool would be utilized) to be used by PMO Team to conduct O&S performance trades during technology and EMD phases.
• Agreement on "when" in the process the tool would be applied to ensure the process was not done "too late" in the design consideration process.
• Standardization of the application of consistent performance and sustainment measures throughout the system life, especially for legacy systems which may not have specific measurable performance requirements.

Lessons:

• In a statement of objectives (SOO)/statement of work (SOW) environment, technical discussions related to RTOC and O&S framework tool language must include

specific expectations and desired outcomes (to include source selection and/or contract negotiations).

- Alpha contracting techniques should be employed to the maximum extent possible.
- Strong top-level leadership buy-in: There must be commitment from the program management, chief engineer, cost lead, and assistant program manager logistics (APML) to iteratively and collectively mandate affordability throughout established goals and agreements.
- Affordability must be a performance consideration from the beginning throughout the life cycle. There must be a balance between performance and affordability during any trade-off analysis during design/development.

Conclusion

Use of a tool like the O&S framework will hopefully enable your PMO to aggressively manage future O&S costs as part of your overall acquisition strategy. As is shown in the PMA-213 JPALS example, to incorporate a standardized process requires top management buy-in from the entire PMO team (including the industry counterpart), and will require planning and oversight as early as possible within a program's acquisition life cycle. It will be these programmatic planning and oversight steps that will help identify the O&S cost elements for each program to track—because each program will need to arrive at their specific O&S cost elements as the way to best monitor their program's O&S cost status.

The expectation is that the emphasis on "affordability" will not be diminishing any time in the future. So spend the necessary time to determine what key O&S cost elements are right for your program and then manage to those cost elements to a fault.

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Phased Contracting Process Improves Requirements and Life Cycle Cost Estimate Fidelity

Maj. Brent J. Gagnard, USAF

Uncontrolled cost growth. Nunn-McCurdy breach. Program manager relieved of position. Not the words any program manager predicts hearing at a milestone review but always in the back of every PM's mind as he/she assumes the helm of an ACAT program—because cost growth has always been a problem in DoD acquisitions.

In 2011, the Government Accountability Office (GAO) in its biennial list of federal programs deemed at high risk for "waste, fraud, abuse, mismanagement, or in need of reform," again listed the DoD weapons acquisition system, as it has since 1990. For 96 major defense programs, the report estimated total acquisition cost growth in fiscal year 2008 at $303 billion (in 2011 dollars), accompanied by an average delay of 22 months in delivering initial capabilities. Given these statistics, a flexible, tailorable, and pragmatic contracting process is not only needed but has been called for by Congress all the way down to program leads.

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The major culprit in cost/schedule growth is estimating full program costs before you know exactly what you are going to design, purchase, build, and test. Funding limitations, technical challenges, and accurate representation of requirements are all complexities that change the equation—factors only known once you begin development. Add to that the acquisition Cold War mentality of mistrust between the government and industry sides of the partnership. To combat these factors, Boeing has implemented a phased joint approach in contracting methodologies called the joint business process (JBP) across its Airborne Warning System programs. The joint business team uses an incremental proposal development process to develop technical understanding and improved costing proposals, saving costs across the total program life cycle. In short, better proposals lead to better program execution.

The secret is the simplicity and basis in common sense. Every writer knows the first draft requires reviews and edits to find its potential. Traditionally, contracting officers request a single draft proposal on a best guess of requirements. JBP simply opens the process to mutually reviewed drafts for products on both sides. That means sharing previously sensitive data, such as budget allo-

cation from the customer, and being open to feedback, such as a critical analysis of requirements and alternatives by the contractor. Steadfast conservatives will protest, "You can't share the government's cost bogey with the contractor."

A review of the facts shows no reason not to be open. Critics warn if you give contractors a number, every proposal will match it. True—but in everyone's favor. Very few RFPs ask for less than the program can afford. The old practice of asking for the world and then hacking at the pricing to afford it is wasteful and inefficient, and it generates animosity on all sides. By providing a bogey upfront, the government/industry partnership have the opportunity to make real-time cost trades during proposal development to balance key requirements with very real cost limitations.

In addition, government will need to accept that industry is not best served by gouge-pricing every proposal. While it is true that industry is built on a profit incentive, industry employees are also Americans who have a patriotic commitment to those serving in uniform. If legally required certified pricing data is not sufficient to quell resistance, one must understand that the typical
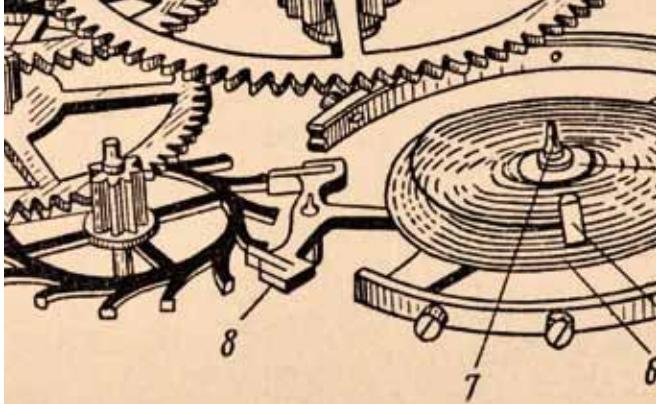
> **By testing the waters, decision makers can begin the next phase with eyes wide open to the risks and objectives while not committing taxpayer money to a great unknown.**

industry manager has no profit incentive in his pay but rather evaluated by his or her ability to meet technical goals on time and on cost. Shareholder value likewise is not enhanced by a short term spike in price, but by consistent customer satisfaction in a quality product that drives repeat business. Reversing the conversation, the requirements first generated by the program office are by no means perfect. They represent a summary-level best guess of a translation from warfighter's combat needs to a technical solution.
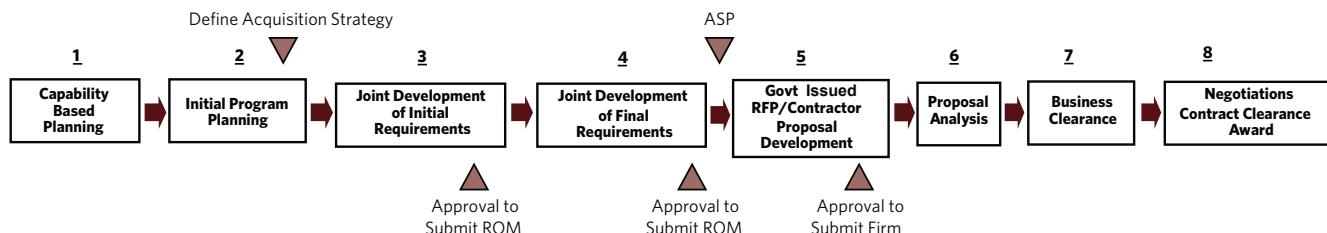
Try explaining your technical requirements in building a new house to an architect while being completely accurate and explicit on the first attempt. This is not the way it works. Instead, the architect takes a day and develops a draft sketch of the new home for the customer to review. They then discuss price point options and make refinements. They continue the process until both sides understand and agree to the final design, price, and schedule. If government admits that RFPs are a first draft and lets the true experts in industry coauthor the deeper technical capability specifications in varying detail, the conversation will likely produce a better understood, more ac-

curate set of requirements and technical challenges/risks on which to base pricing.

On the surface, JBP appears to increase the contracting schedule timeline, but given most traditional contract awards are quickly followed by clean-up and scope adjustment mods plus the fact JBP actually allows work to begin much sooner, the overall schedule is reduced and more effective. Requirement and proposal development are incrementally performed in eight tailored, separately funded phases relying heavily on partnering between the program office and the contractor to complete. Each phase allows greater clarity into the program's challenges, limitations, and capabilities before committing to the next. Conversely, these decision points provide convenient off-ramps if the effort needs to be aborted or suspended due to resource constraints or warfighter requirements change before a total commitment of funds to the effort. If a technology isn't progressing sufficiently to meet a major need or the current budget cycle is not favoring the project, it can be cleanly shelved or restructured for a future restart. By testing the waters, decision makers can begin the next phase with eyes wide open to the risks and objectives while not committing taxpayer money to a great unknown. Industry is incentivized to perform during these phases to compete for the follow-on work and potentially invest in industry-funded research and development if the business case supports it.

Phases 1 and 2 begin like any other new effort, as a need is identified. The JBP engages within the existing RFP structure by enhancing the data products beginning in phase 3. Phases 3 and 4, led by the program manager, are conducted by integrating alpha contracting with full, open, honest, and active dialogue. Trust is key during the process, as the parties conduct objective versus threshold requirement cost trades, contemplate contracting strategies, and establish budget benchmarks. It is in these phases that decisions are made as to whether the program should be firm fixed price (FFP) or cost plus, so risk and pricing strategies can evolve. While sufficient proposal preparation funding is provided for each phase, the major difference is additional funding for preliminary technical development. By doing initial technical development functions, the team gains greater insight into future risks and focus areas while spending minimal funds that would have been used anyway in a full-fledged award. In return, both sides develop a preview without full and total commitment. The best analogy is an auto mechanic giving an initial estimate before

Figure 1. Joint Business Process

1	2	3	4	5	6	7	8
Capability Based Planning	Initial Program Planning	Joint Development of Initial Requirements	Joint Development of Final Requirements	Govt Issued RFP/Contractor Proposal Development	Proposal Analysis	Business Clearance	Negotiations Contract Clearance Award

Define Acquisition Strategy

ASP

Approval to Submit ROM

Approval to Submit ROM

Approval to Submit Firm

work starts but providing a better estimate once some labor is spent exploring the problem. If the educated estimate is too high, you recover the vehicle with minimal out-of-pocket cost. But expecting a firm estimate without the benefit of looking under the hood, which overcharges either the customer or the shop, is foolhardy and, in the world of defense acquisition, is a major cost/schedule driver.

Phases 3 and 4 culminate in submissions of rough orders of magnitude (ROM) including suitable statements of work (SOWs). Each ROM adds more fidelity and confidence, focusing primarily on hours and material costs, as a foundation for decision making to enter the next phase. They also provide a convenient deliverable to manage contractually, but in reality the true deliverable is the framework for the contracting strategy and detailed technical definition. In the traditional approach both sides have to fully commit placing all their chips down before either side knows what surprises lurk. In contrast JBP provides a look under the tent and a strategy session ending where both sides have a handshake on how the program would move forward built firmly on the chassis of the previous phase.

Phase 5 transitions to a traditional contracting process using the refined SOW in the RFP. The contracting officer takes formal control of the process issuing the RFP and accepting the formal proposal to end phase 5. Technical evaluation and requests for information are conducted in phase 6 but should be more of a formality, since the technical merits were developed jointly. Legal counsel reviews the case in phase 7, permitting the PCO to negotiate with the contractor in phase 8, and due diligence is exercised to provide legally required fiduciary responsibility. The timeline is extremely expedited, since the intended work has been widely documented, alpha negotiation has resolved most major disconnects, and a firm proposal is quickly generated in phases 3-5. By this point, labor hours have informally been agreed upon, so all that is left is to negotiate rates, factors, and fees progressing to phase 8.

The inability to acquire joint defense capabilities at contracted costs and within scheduled timeframes is a continuing DoD problem. The standard "over the fence" contracting method of requesting sealed bids consisting of industry's best guess of the warfighters' needs has demonstrated for decades that the process does not work. Given that DoD is entrusted with more taxpayer dollars than any other federal agency, it is incumbent upon program managers to identify and implement contracting strategies that produce improved acquisition outcomes. At the same time, program managers in government and industry owe it to the warfighter to deliver effective war winning solutions as promised. The JBP offers a structured teaming approach to better requirements definition, estimating, and planning—serving the taxpayer through reduced rework while preserving manpower and funding. In the age of significant budget shortfalls and lean initiatives, such a promising and tested solution must not be overlooked.

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Lean Implementation

A Three-Pronged Attack

David M. Riel

T he first lines of A.A. Milne's classic, *Winnie the Pooh*, read: "Here is Edward Bear, coming downstairs now, bump, bump, bump, on the back of his head, behind Christopher Robin. It is, as far as he knows the only way, but sometimes he feels that there is another way, if only he could stop bumping for a moment and think of it."

That classic line sums up what the DoD acquisition leadership is asking us to do. Our military systems "will cost" what they historically have unless we take the time to "stop bumping for a moment and think of it." Dep. Sec. Ashton Carter, Ph.D., and John Mueller, DAU professor of program management, in their *Defense AT&L* article, "Should Cost Management: Why? How?" (Sept–Oct 2011) rightfully state that program managers should "call in the assistance of Lean Six Sigma experts to assess your processes and trim the fat. Encourage your contractors to similarly self-evaluate and jointly look at inefficiencies in processes you engage in together." In addition, DAU professors S.L. "Dusty" Schilling, Gordon Hagewood, Harry Snodgrass, and Peter Czech wrote in their *Defense AT&L* article, "Manufacturing Affordability" (Sept–Oct 2011): "the most fundamental truth is that early and persistent

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planning during design is critical to enabling manufacturing affordability during production." That also is absolutely true.

Nevertheless, if you are managing a program that is post-CDR, there are still positive steps you can take and/or encourage your contractor to take to achieve "should cost" goals. Employing lean is one of those tools. Inopportunely, most PMs I have talked with think of lean only in a tactical sense: value-stream map a process, look for the non-value added, and "trim the fat." While this approach may grant some short-term gains, long-term success of lean requires a three-pronged attack—adding cultural and strategic to tactical.

Cultural Initiatives

Early on as senior manager of manufacturing and continuous improvement with an aircraft refurbishment division of a defense contractor, it became apparent that if we were to attain an attitude of continuous improvement—faster, better, cheaper—we needed to create a culture that would allow lean to thrive. Every set of skilled mechanic's hands came with a free brain, and we needed to tap that resource. The first step was to ensure that our touch labor felt valued and to foster in them a sense of ownership for each aircraft we needed to get back to the warfighter. By reviewing the enterprise resource planning (ERP) system, we noted that the last aircraft to deliver had over 400 touch-labor personnel charged to it. From that point, we created "core aircraft teams," allowing the same team of touch labor to stay with their aircraft as much as and for as long as practical. Recognizing that people want to be part of something important, we replaced our company-oriented banners, reading "Growth through Productivity," with customer-oriented ones reading "Delivering War-Winning Capability Back to the Warfighter!" What are the companies you are teaming with emphasizing?

Frankly, when we reviewed our employee survey data, "valuing people" was among the lowest-ranked categories. So we also made a huge push in our reward and recognition program. For reward systems to be effective, the more immediate the recognition, the better. We used value stream mapping to reduce our "on the spot" recognition program from a 2-week process to about 30 minutes. We also asked our supervisors to reserve the center of their new production boards to recognize their top employees—those that saved time and/or money through the quality of their work. We made it a priority to visit our employees on their birthday and work anniversary dates. In essence, we started treating our employees like we were lucky to have them instead of like they were fortunate to work for us. Whenever possible, we got our customer involved in our recognition programs. While employees were pleased to receive recognition from company leadership, the recognition gained meaning when presented by our customer. Our customer was also willing to give a tour of the finished aircraft prior to it flying away. Suddenly, those "parts" being fabricated became an aircraft with a mission in the global war on terrorism. One manufacturing employee with over 20 years working for our company told me this was the first time he had gotten to con-

> **Every set of skilled mechanic's hands came with a free brain, and we needed to tap that resource.**

nect what he did in the back shop with the final product. Time and money well spent.

The results spoke for themselves: Turnover rates, an important indicator of employee satisfaction, declined over a 3-year period, from greater than 20 percent to 5.1 percent. Profits increased, as well. Not all of this resulted from our culture efforts, but they were an important, foundational piece of the puzzle. The next piece was our strategic initiatives.

Strategic Initiatives

Strategic initiatives are those lean activities that every company should be doing—such as 6S, point-of-use and visual factory. They are not company specific. As most lean practitioners will acknowledge, 6S—safety, sort, set, shine, standardize, sustain—is foundational in establishing a lean enterprise. I joined the facility just 9 months after one of our USAF customers described our cluttered hangars as "Sanford and Sons." (I still can't get that theme music out of my head!) Not surprisingly, 6S became a focus shortly after, initiated with monthly competitions at the hangar-level. We noted some nice improvement, but the initiative lacked ownership, since the hangars didn't really belong to anyone. So we shifted the competition to the aircraft level, and identified core teams from each aircraft. It's human nature to enjoy good competition, and we were reaping the benefits. The improvements were significant. Within 3 years of that original e-mail, that same USAF customer was sending others our way to view our facility's gains. How well is your contractor doing with 6S?

At the same time that we were getting our workplaces organized, we recognized that the more we could provide the mechanics what he/she needed as close to their work as possible, the faster the job could be done. In lean terms, we were reducing the waste of motion. How would you like if during surgery, your surgeon had to go to the other side of the hospital to get her scalpel, and then hike across to another part of the hospital for the sutures? Not acceptable, right? Establishing point-of-use for a factory is the same concept. Instead of having consumables and expendables centrally located in the hangar, we made them available plane-side in smaller, portable

stations. Less walking meant more time with the "patient"— our customers' aircraft.

Another important initiative was making the facilities and work more "visual" to everyone. We developed and deployed production boards at every aircraft. This visibility provided the aircraft supervisor and division leadership with key metrics—major milestones, 2-week schedule, earned value management (EVM) data, material shortage tracker—used to assess the health of the aircraft. We also included a countdown clock, which counted down the seconds until the next milestone had to be accomplished to stay on schedule. When that clock hit 0:00, we knew we were behind. Perhaps the most useful item on those boards was the action item list. That list included what actions needed to be done in order to hit that milestone and who was responsible for making it happen. Division leadership visited each aircraft weekly, where the aircraft supervisor used the production board to present status.

Tactical Initiatives

With cultural and strategic initiatives gaining momentum, we turned our attention toward the tactical; those projects that are program-specific. One customer in particular was anxious to get their assets back since they were scheduled to go to war within a couple of months of our delivery. They joined us for value-stream mapping several of the processes we worked together—e.g., final aircraft inspection ("shakes"); rack and console installation; and aircraft paint. Through teaming and making aircraft delivery the number one priority, we were able to significantly reduce the "shakes" process from over 60 days to 15 days on average. The racks/console installation process was cut in half from 45 days to 22 days. Aircraft paint re-

duced by 2 days with over 150 labor hours saved. As you can imagine, teaming with our USAF customer was essential in making these gains. Also, a motivated, stable workforce and 6S in place were critical in creating and sustaining these gains. How have you partnered with your contractor to create win-win situations?

Since this article focuses on our success, it may give the impression that everything went smoothly. Not! Not even close! Change is hard. Even with strong upper management support, for every two steps forward, we took a step back. Some initiatives didn't work, so we ended them. Some worked better than we ever imagined they would. To quote Thomas Edison, "Opportunity is often missed because it's dressed in overalls and looks like work." Pursuing these initiatives is definitely a "roll-up your sleeves" task. Persistence and dedication to the continuous improvement process was required and key. For those Steven Covey fans out there, this is definitely "quadrant 2" stuff—important, but not urgent. Your contractor partners and you are likely busy with quadrant 1 (important and urgent) or even quadrant 3 (urgent, but not important). To be successful, the team—contractor and government—must carve out the time and energy to pursue these important yet non-urgent activities.

As you pursue "should cost" initiatives, be sure to see lean as a three-pronged attack. Although tactical lean activities will identify key savings areas, fruition and sustainment of those savings may very well depend on cultural and strategic enterprises.

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Success in Chemical Weapons Stockpile Elimination:

The Intersection of Risk and Vision

Larry Marshall ■ *Om Handa*
Lisa Proctor ■ *Janice Muscella*
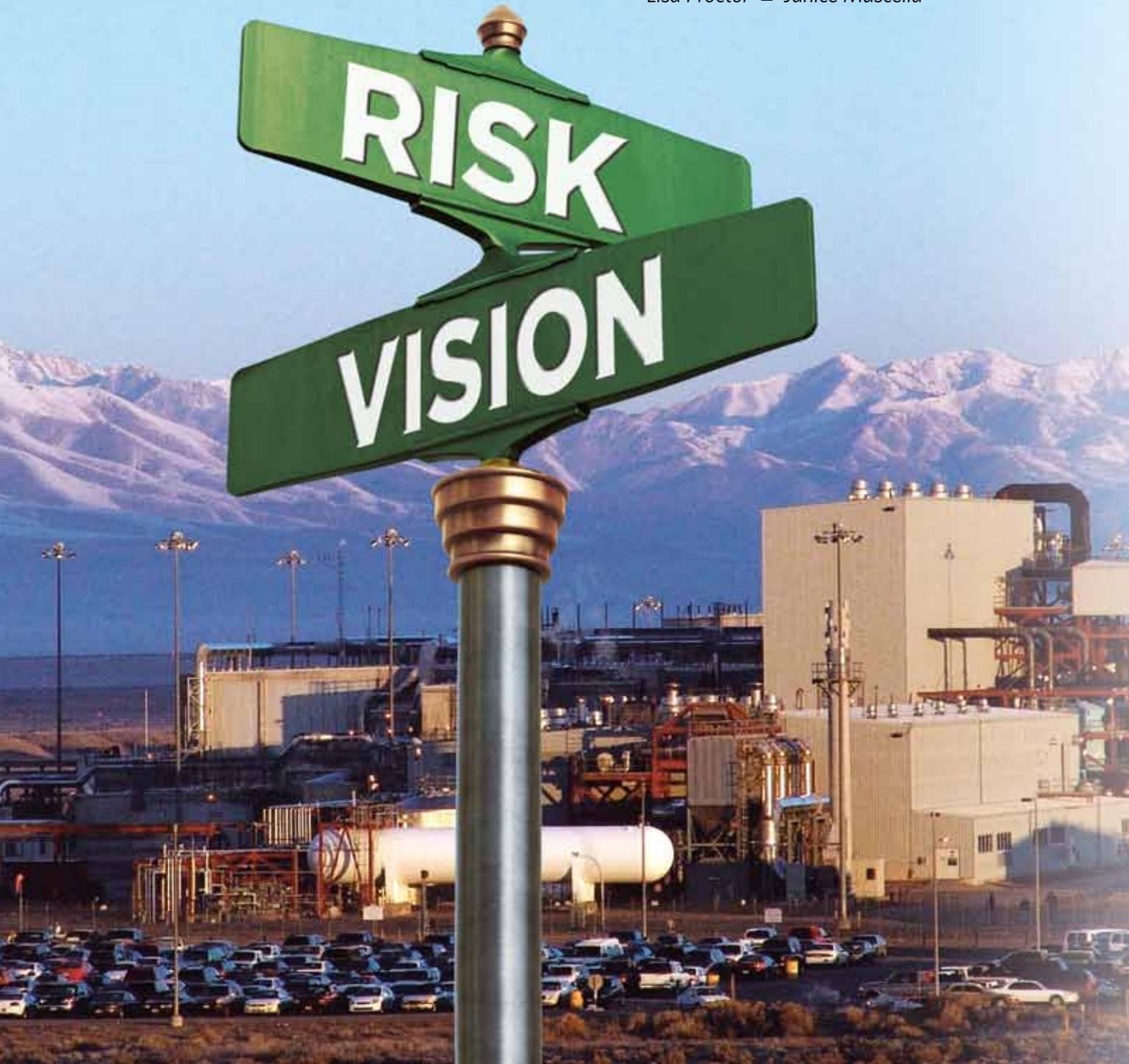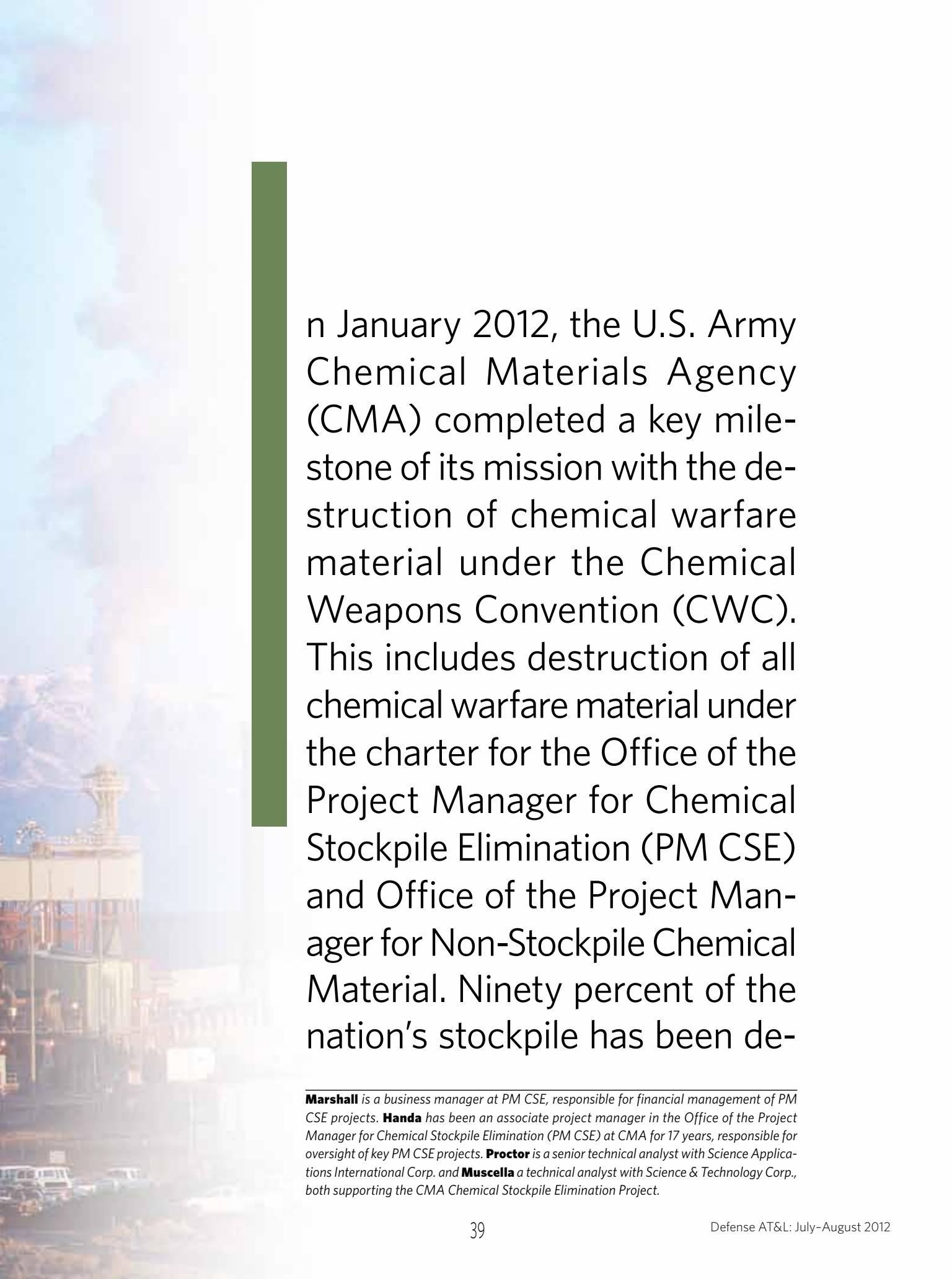
n January 2012, the U.S. Army Chemical Materials Agency (CMA) completed a key milestone of its mission with the destruction of chemical warfare material under the Chemical Weapons Convention (CWC). This includes destruction of all chemical warfare material under the charter for the Office of the Project Manager for Chemical Stockpile Elimination (PM CSE) and Office of the Project Manager for Non-Stockpile Chemical Material. Ninety percent of the nation's stockpile has been de-

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stroyed. The agency has a remaining mission to complete the environmental closure of the last four of seven chemical demilitarization facilities. This is a significant achievement and a great opportunity to reflect on the successes and lessons learned and to highlight those strategic changes in contracting at the last four facilities that helped reach this milestone 3 months prior to the treaty deadline and at a projected cost avoidance of $5.7 billion to the taxpayer. These four facilities destroyed more than 75 percent of the total stockpile eliminated.

Scope: Rapidly Changing Requirements and Initial Costs

Destruction of the U.S. chemical weapons stockpile of more than 30,000 tons of lethal liquid chemical agents stored in 3.3 million munitions and bulk containers was a formidable challenge for the Army. In 1986, when Congress authorized disposal of the nation's aging and deteriorating stockpile, there were many unknowns about the condition of the munitions and chemical agents they contained. This venture would be the first of its kind. The entire spectrum of federal, state, and local environmental requirements applicable to the site stockpiles was undefined, destruction technology at full scale was not proven, and little industrial experience existed for the task, beyond that gleaned from the Army's research and development facilities.

As is typical at the beginning of a program's acquisition life cycle, scope based on initial requirements, maturity of technologies or best available technologies, cost, funding, and schedule estimates were still being defined. At the outset, the government defined requirements in broad prescriptive terms and played a significant role in determining how contractors would operate to meet initial program and contract requirements. Initial cost estimates for the destruction of the chemical weapons stockpile in 1986 were $2.1 billion. At the time, only the government held expertise and technology related to chemical agent munitions and demilitarization operations. This knowledge was based, in part, on pilot operations at the government-owned/government-operated Chemical Agent Munitions Disposal System (CAMDS) in Tooele, Utah, as well as operations previously conducted by the Army.

The contracting acquisition strategy for the first full-scale facility, Johnston Atoll Chemical Agent Disposal System (JACADS), deliberately administered and awarded separate contract vehicles for design; facility construction; equipment acquisition, installation, and systemization; and project operations. In the early 1990s, as construction and testing (systemization) was being completed, the Army estimated a life cycle cost increase of the program to $6.5 billion. Design and testing of incineration-based chemical demilitarization facilities within the continental United States (CONUS) were ongoing, with ever-increasing changes in legal and environmental requirements, mission requirements, public concerns, and available acquisition strategies. Multiple, competing contract awards were intended to encourage competition. However, they diminished the desire and efficiency of contractors to work together and contributed to cost and schedule growth.

Challenges and Lessons

Based on lessons learned at JACADS, the Army determined that all aspects of each CONUS site's construction, systemization, operation, and closure would be awarded to a single systems contractor. Design of all of the incineration-based facilities would be awarded to a single contractor, to ensure design continuity and uniformity among the sites. This approach was followed for all future sites, starting with the systems contract award for the Tooele Chemical Agent Disposal Facility in September 1989.

In compliance with Public Law 102-484, the Army in 1994 established the Alternative Technologies and Approaches Project (ATAP), primarily aimed at the two sites that only stored bulk containers of chemical agents. The ATAP acquisition strategy also combined responsibility for all life cycle phases for these two demilitarization facilities—design, construction, systemization, operations, and closure—into a single system contract. This approach, as well as that for the four incineration-based facilities, would act as the precursor to the final life cycle contracting approach implemented at all CONUS sites.

In 1997, as the United States signed onto CWC, an international treaty requiring 100 percent destruction of chemical agent munitions by April 2007 (later extended to April 29, 2012), challenges to the program continued to emerge and escalate. With each of the four incineration-based facilities in a different phase of its life cycle (construction, design, installation, testing, or startup), the Army continued to face integration issues among the systems contractors; this led to further schedule slippages and continued program cost escalation. Increased environmental activism, litigation, and tightening of Environmental Protection Agency (EPA) standards and state regulations also contributed significantly to delays. The problem was exacerbated by overly aggressive program assumptions, first-of-a-kind processes, and worsening condition of the aging stockpile. Changing requirements and stakeholder expectations led to modifications to the design of the plants and equipment leading to frequent contract changes, and cost and schedule growth. At this point, the project cost had soared to approximately $24 billion, and was under very high levels of scrutiny by both Congress and the General Accountability Office.

As late as 2006, there was minimal likelihood of meeting the extended CWC deadline of April 29, 2012. It was at this point that the Army identified the need to have a life cycle focus and to motivate multiple systems contractor(s) to work collaboratively and aggressively while maintaining highest levels of safety and environmental focus.

Change Requires Change: Contracts, Award Fees, Incentives

Moving toward a life cycle approach allowed the project manager to motivate the systems contractor with additional profits

through increased efficiency. One of the first strategic changes the project manager implemented was to develop and use a risk-based schedule and cost model. Based on historical processing rates and identification of program risks, PM CSE was able to develop the best, most reliable, and most auditable schedules and costs.

In 2006, PM CSE decided to establish life cycle schedules and use them as the basis to negotiate required systems contractor resources, target cost, and fee pools. Life cycle contracting placed responsibility of the entire process from operations through closure on the systems contractors, in lieu of annual levels of effort negotiations, as had been done in the past. This redirected responsibility was the only way to achieve agent destruction by the CWC deadline.

Cost-reimbursable contracts continued to be the most appropriate vehicle for completing the remaining operations and closure of these projects, due to many remaining technical, regulatory, and political risks; the lethal nature of the chemical munitions; and the congressional mandate for maximum protection of the workforce, the public, and the environment. It was not possible to define the scope sufficiently to use fixed fee-type contracts.

With congressional support, CMA was able to put in place multiple performance incentives on contracts, to encourage timely and cost-effective completion of operations and closure of facilities, while maintaining the highest levels of safety and environmental compliance. Award fees are a critical part of the contracts and encompass safety, environmental compliance, cost, schedule, and management—with a significant emphasis on safety and environmental compliance. The project manager had two key incentives for schedule acceleration. The CWC requires all signatories to destroy all chemical weapons no later than April 29, 2012. In addition, Congress passed the CWC Implementation Act of 1998 to reinforce the U.S. commitment to destroying the stockpile. Moreover, each of the four incineration-based facilities has contract values of $10 million–$20 million per month; early completion of operations and closures would result in significant program cost avoidance.

Initially, from 2005 to 2007, a CMA director's programmatic performance-based incentive (DPPBI) was established to augment the award fee incentives. The DPPBI was a means to encourage the systems contractors operating the four incineration-based facilities to collaborate and use their combined expertise to mitigate programmatic risks, including actively sharing lessons learned. However, there was still concern that even with the DPPBI, the four incineration-based facilities might not meet the final CWC milestone.

Using the scheduling tools available to the project manager, it was determined that the confidence to meet the CWC deadline was 19 percent at best at one site and less than 10 percent for the remaining three incineration-based facilities.

With each of the four incineration-based facilities in a different phase of its life cycle, the Army continued to face integration issues among the systems contractors.

Significant action had to be taken to meet the revised CWC date of April 29, 2012. To increase the probability of meeting the treaty deadline, the project manager proposed a significant schedule incentive approach, with a focus on accelerating chemical agent munitions disposal operations and closure of the facilities. In 2007, with the passage of Public Law 109-364, the John Warner National Defense Authorization Act, Section 923, CMA incorporated additional incentives into the contracts without delay.

The schedule incentives placed strict performance milestones on the contracts with April 29, 2012, as the key end of operations milestone. The investment of the maximum payout would be offset by the resulting schedule savings and other program cost savings as a result of finishing early. At the time the incentives were put into place, the project had a program estimate of $24.3 billion. As of January 2012, all four of the incineration-based facilities on which the incentives had been placed have completed operations and the current program office estimate is $18.6 billion, resulting in a projected cost avoidance of $5.7 billion.

Blueprint for Success: Expectations, Motivation, Integration of Commercial Solutions

Congressional support in allowing the use of an incentivization approach had a measurable and highly positive impact on the schedules without sacrificing safety or environmental compliance, and consequently in achieving project success at significantly lower cost in meeting the CWC deadline. This is due, in no small part, to the four core operational evaluation expectations put in place—safety, compliance, reliability, and margin—as well as the use of compliance assessments, performance improvement, and integration methodologies. This new strategy set the stage for the synchronization of the government and systems contractors' goals.

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Motivation for the systems contractors to meet or beat defined milestones became a paramount force that led to their adoption of safe, innovative, commercially available technologies in order to continue to reduce schedule risk and meet the CWC target date. Prime examples were the pursuit of explosive destruction technologies to process non-standard, problematic munitions; additional available technologies and alternatives to destroy the nerve agent tabun (also known as agent GA) and blister-agent L; and heel-transfer systems to facilitate the processing of heels in the ton containers that were otherwise proving very difficult to remove.

Alternative solutions were not only chosen to meet programmatic milestones, but also for the quickest reduction in overall risk and added safety to the workers, public, and the environment. Safety has always been the cornerstone of this project, something that would never be compromised. Despite highly hazardous operations being routinely conducted with lethal chemicals, the contractors were able to accomplish recordable injury rates at levels comparable to those of public libraries while finishing ahead of the contract schedule. In addition, each of the four demilitarization facilities achieved the Occupational Safety Health Administration's (OSHA) Voluntary Protection Program–Star Status. This is OSHA's highest recognition, given only to companies with comprehensive safety programs and injury and/or illness rates at or below the national average for their industry. Approximately 0.2 percent of companies in the United States receive this recognition.

The largest decrease in risk to the public occurred with the elimination of all sarin (agent GB) rockets on May 19, 2007. The destruction of the chemical weapons stockpile at the last four incineration-based facilities resulted in the complete elimination of public risk to the communities surrounding the facilities.

Success

In January 2012, the project manager for chemical stockpile elimination, along with the systems contractors and primary stakeholders, completed the safe elimination of the entire stockpile that the project manager was chartered to destroy approximately 3 months ahead of the CWC deadline and at a projected cost avoidance of $5.7 billion to the program and to the taxpayer. Table 1 shows the number of months each site is projected to complete closure ahead of the 2005 program office estimate.

Table 1.

Site	Number of Months
Anniston Chemical Agent Disposal Facility	39
Pine Bluff Chemical Agent Disposal Facility	31
Tooele Chemical Agent Disposal Facility	36
Umatilla Chemical Agent Disposal Facility	45

In conclusion, the introduction of the new contracting strategy and use of the life cycle contracting approach, with congressional approval of the schedule incentive program, resulted in a significant and measurable success on this program. &

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Be accountable.

You'll probably get the blame anyway.

Wayne Turk

isten to the news: Someone or some entity is always getting the blame for something that has gone wrong. Sometimes people step up and accept the blame. That is accountability. Accountability (or the lack of it) has been a hot topic lately, whether related to politics, sports, banks, the deficit, the Euro, or just management in general. We'll limit this to accountability in business and projects.

When it comes to accountability, there are three levels to consider. The first is organizational accountability; the second is management (or manager) accountability; and the third is worker accountability. There are similarities in all three.

Turk is a retired Air Force lieutenant colonel and defense contractor, and the author of Common Sense Project Management *(ASQ Press, 2008). He is a frequent contributor to* Defense AT&L*.*

Important in creating a culture where accountability is the norm is rewarding those who are achieving their goals and correcting those who are not.

Organizational Accountability

Let's begin at the top, with the organization, and work down. In 2002 Congress got into the act and passed the Sarbanes-Oxley Act, also known as the Public Company Accounting Reform and Investor Protection Act of 2002. It sets specific mandates and requirements for financial reporting and was the result of a number of scandals that cost investors billions of dollars. The Act is administered by the Securities and Exchange Commission, which sets deadlines for compliance and publishes rules on requirements. While it doesn't apply to DoD or other parts of government, it does to the myriad of contractors who support our government. Sarbanes-Oxley is not a set of business practices and does not specify how a business should store records, but does define which records must be stored and for how long. I won't get into the particulars of the Act. If you are interested, there is a veritable plenitude of information available.

Integrity in the accounting standards is a start. This applies to government and projects, as well as businesses. It is part of organizational accountability. However, it is only a part. Another part is the willingness to be open and forthright, accepting blame for mistakes or problems. That is difficult for companies because it can and does affect their bottom line. Recalls and lawsuits are expensive. Investors and owners are looking for profits. But accusations of cover ups and the subsequent bad publicity can be just as expensive or even more so. While it doesn't affect the bottom line for government, it does affect credibility and can directly affect subsequent funding, among other things. Since few of us are at the level of decision making that sets the standards for openness in the organization, we can leave it at this: Organizations need to take responsibility for their actions and mistakes.

The previous two points involve external accountability. Now we get more into internal accountability. This starts with the vision and mission of the organization. If everyone in the organization does not know and understand what the vision and mission are, how can they be accountable for supporting it and making it happen? This just reinforces the need for open and full communication that has appeared in many previous articles.

Accountability continues with the setting and monitoring of goals and objectives. A key component to accountability is expectations. There have to be corporate goals, departmental goals, team goals and personal goals. They need to be SMART goals. That means that the goals are: specific, measurable, attainable, realistic, and time-constrained. (Just a little mnemonic to help you remember.) A goal that meets the SMART criteria will be one that all parties involved can feel good about, and includes all information needed to foster success and allow adequate measuring. As you can see, this is one of the requirements for accountability that affects every level.

Important in creating a culture where accountability is the norm is rewarding those who are achieving their goals and correcting those who are not. This is something that is very often overlooked. People tend to notice when some are falling short, but take it for granted when others are accomplishing their goals. Corporate, Service, departmental, and team goals need to be publicized and the status/results freely available to all. Having individuals report to and be accountable to their workmates can help create a truly high-performance team, but that is a matter of your management style. But always recognize and reward those who meet their goals.

The culture of accountability begins at the top and encompasses all levels of the organization. It involves everyone, but especially managers, so let's move on to the management level.

Management Accountability

As was said earlier, there are many similarities for accountability at all levels of the organization. Most of accountability falls under common sense and blends with how to be a good manager. Here are some descriptions of manager actions and attitudes that show whether he is accountable or not:

- Managers say what they are going to do. They communicate their plans and decisions, keeping people under (and over) them informed.
- They do what they said they would do. They follow through, linking their actions to their words. They "walk the talk."
- When they are not able to do what they said they would do, they explain why promptly. They let their employees and others know what happened to prevent them from following through on their word. Not excuses—explanations. Then they go back to bullet 1.

- They try not to have to do the bullet 3 very often. Credibility comes with consistency and follow-through.
- They share information. This is more than bullet 1. They keep those who need to know, including their employees and their bosses, informed of what is going on.
- They set goals for themselves, their people, and their team. They also explain how those goals will be measured. Then they monitor those goals, providing feedback.
- They consider the results of their actions in advance. That is future accountability. By considering the potential outcomes of actions and decisions, they think about the consequences of what they do. This prevents or lowers the need for the next bullet.
- They take responsibility for their actions and mistakes, as well as those of the people under them. They hold their own people accountable, but the buck stops with the manager. It takes courage to admit mistakes, but it has to be done.
- They learn from their mistakes and help others learn from theirs. Just admitting mistakes is not enough. Managers have to learn from their errors so that they don't make the same or similar mistakes. If it is the mistake of folks under their supervision, they help them learn from the mistakes, too.
- They ensure just consequences when appropriate. Sometimes the mistakes of the employees require actions other than just learning. Those actions have to be both fair and equitable.
- They expect others to behave the same way. This includes everyone in the organization, but especially people who work for them. They must train their employees to be accountable, too.

Here are some of the things that can get in the way of manager accountability. Don't let them get in your way:

- **The wrong corporate culture.** If the organization is not accountable and doesn't reward accountability in its people, it can be hard for a single manager to be accountable and require his people to be the same.
- **Pressure from above.** Sometimes that pressure is for a cover up. Sometimes it is to place the blame for a mistake. Sometimes it is pressure to conform to the culture, if the culture doesn't reward accountability. Finally, it could be time pressure or just pressure to get things done.
- **Unclear or undefined goals and objectives.** Ensure that the goals that you set with your employees are clear. The same with the goals that are set for you by those above you. Everyone has to understand what the goals are.
- **Unrealistic goals.** Stretch goals are fine, but all goals have to be realistic or people won't even try to attain them. If you have unrealistic goals, how can you be accountable if they are not reached?
- **No metrics to measure success.** Everyone also must understand how to measure whether they are meeting their goals. Keep in mind the SMART theory—specific, measurable, attainable, realistic and time constrained.
- **Favoritism.** Showing favoritism prevents you from treating everyone fair and equitably. You then won't expect the same accountability from all of your employees.
- **Shifting priorities.** When every day brings a new "number one" priority, it becomes impossible to make steady progress towards goals. Priorities will change and crises will

arise. That is when good communication helps. You can even change the goals if you have to.

- **Fear of confrontation (whether it is up or down).** Fear of confrontation with your boss can make you accept goals that are not realistic. Fear of confrontation with those under your supervision will not make them accountable. Confrontation doesn't have to be negative. It can be done in a mature, unemotional way.
- **Being overwhelmed with work or crises.** When you are working 12 or 16 hours a day just to stay even, it is hard to think about accountability or squeeze in the actions that you need to take to be accountable.
- **Incompetence.** If you or your people lack the skills to meet commitments, it makes the idea of accountability tough. That is where training can be beneficial.
- **Poor communication.** If the communication channels are not used or if communication is unclear, it is an obstacle to accountability. It is also a detriment to good management period.

Remember that although it is okay for a manager to make mistakes, an accountable manager won't make excuses, point fingers, or play the blame game. Even if it is not your fault but falls under your purview, you are accountable for your actions and your team's actions—for everyone and everything in the area you supervise. When you stand up to accept the responsibility, that's when you are seen as an accountable manager.

Respect for any manager has to be earned. It comes from people seeing your integrity with every decision that you make and every action that you take. So it's up to you to use your people-management skills on yourself as well as with others and accept that success is up to you—assisted, of course, by those working for you. Accountability means there are no excuses.

Worker Accountability

Worker accountability is almost the same as manager accountability, but taken down one level. It is a matter of expectations and level of responsibility.

We want our employees to fulfill our expectations and believe they should be held accountable for meeting or not meeting these expectations. The biggest problem here is setting those expectations and communicating them so that everyone understands what the expectations are. A part of the expectations are the goals for the individual and what we will use to measure success. Other parts of the expectations include attitude, work ethic, skills, work habits, and so on. All of this has to be understood so that supervisor and employee have the same understanding.

When the expectations that we have of our employees are met, we have to recognize and reward them. If they are not, we need to point out the problems and work with the employee to resolve them. There may have to be consequences or "punishment," but make sure that it is just. That concept has been discussed in many articles, so I won't beat it to death.

Managers need to be having feedback sessions with their people on some kind of a regular basis. Let them know how they are doing. If they are doing something outstanding or have met a goal, recognize them in front of their peers.

We want our people to take responsibility for their work and their actions. The concept is the same as for a manager, only the level of responsibility is much lower. Workers are usually only responsible for their own actions. That may not always be true in a team environment, though. There the worker has a shared responsibility for the actions and results of the team.

The concept is also the same that we want our employees to admit their mistakes and learn from them. They can learn that from watching the manager. Remember that you are a role model for them. However, you may also have to encourage them to admit errors.

Final Thoughts

Here are some questions to ask. They are an edited version of an ad for a seminar on accountability, but I think they are apropos for consideration at any time. The answers determine whether you have a culture of accountability:

- Are poor performers ignored, transferred, or promoted?
- Are there goals at every level, and are they "publicized"?
- Is performance execution measured or only business results?
- Are individuals and teams recognized and acknowledged?
- Do people hide from responsibility?
- Are problems and conflicts avoided?
- Do priorities compete?
- Are values ignored or taken for granted?
- Is there an atmosphere of change resistance?
- Are people punished for their mistakes?

The answers will point out problem areas or areas for improvement in the organization or in yourself. Make the changes. If you are trying to change the whole culture of the organization, you may have to take it in increments and it may be slow, but it will be worth it in the end.

Remember:

- Accountability must begin at the top and run through the entire organization.
- Good communication is paramount.
- Clearly defined goals are essential at every level.
- Good, usable (SMART) metrics are critical.
- A strong monitoring and feedback system helps create success.
- Consequences are part of the process.
- Everyone learns from mistakes.

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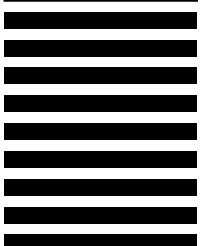
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May-June	1 February
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November-December	1 August

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